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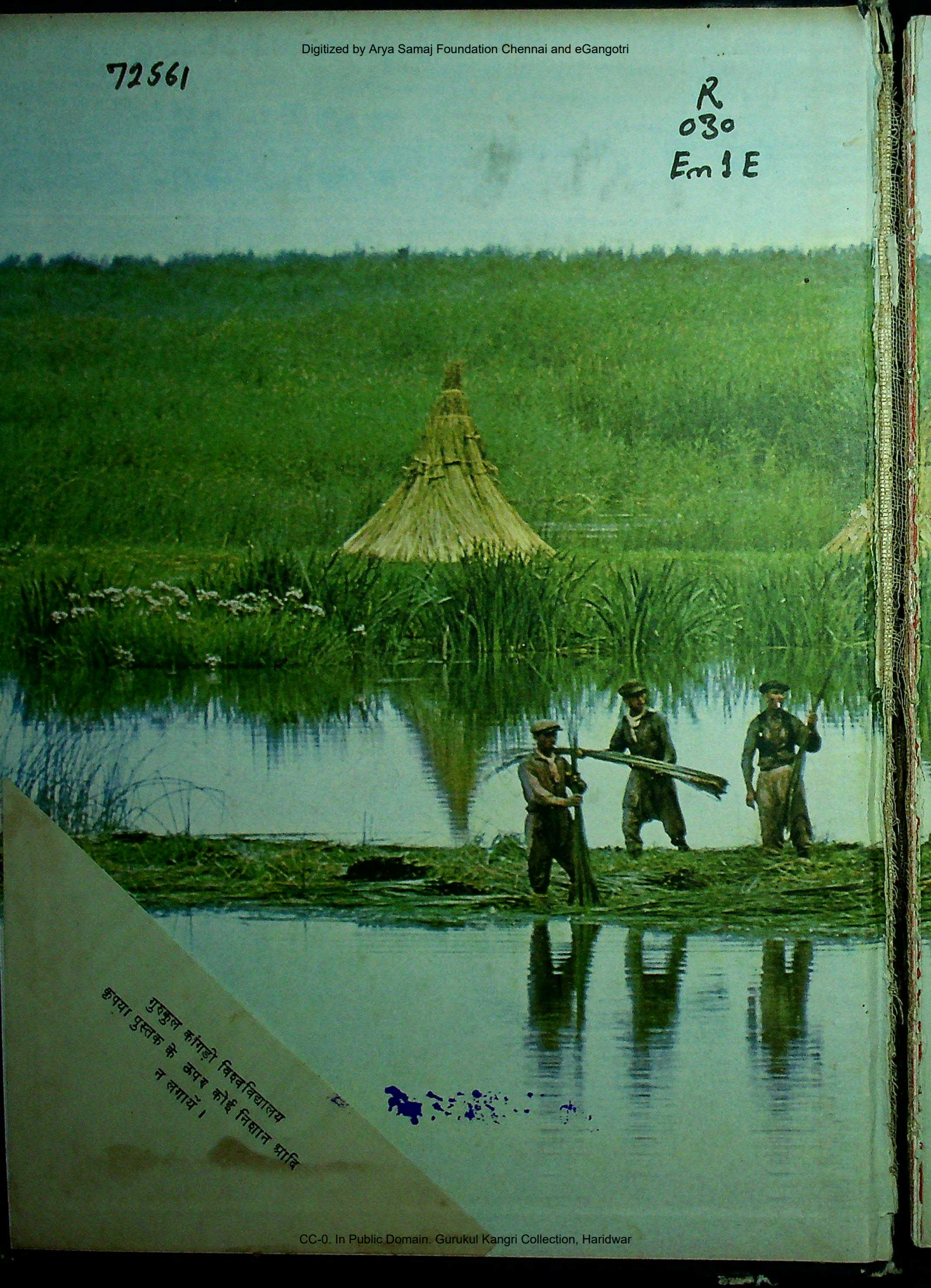

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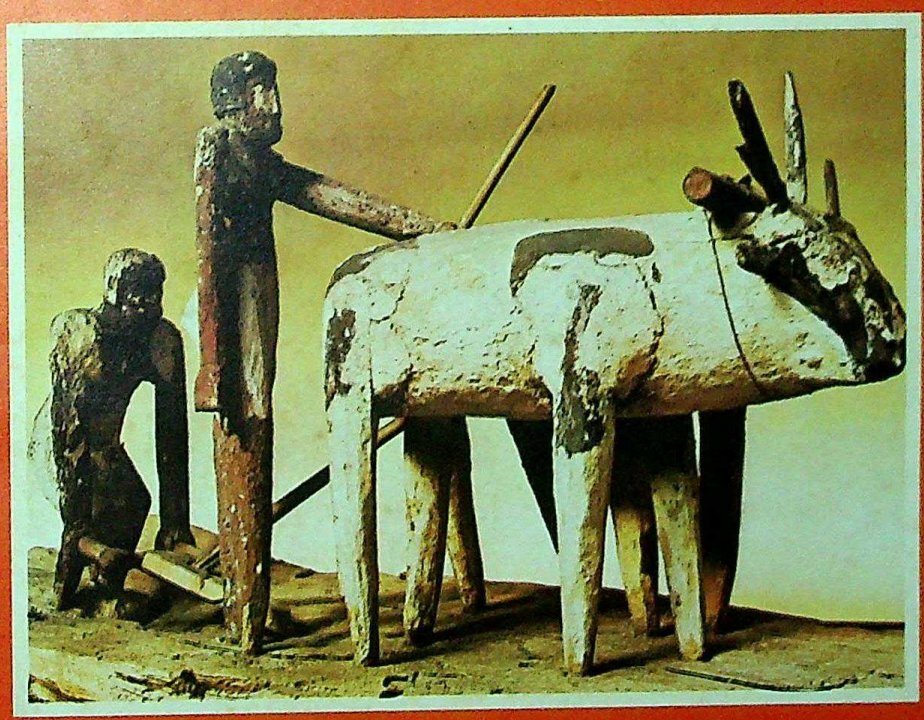

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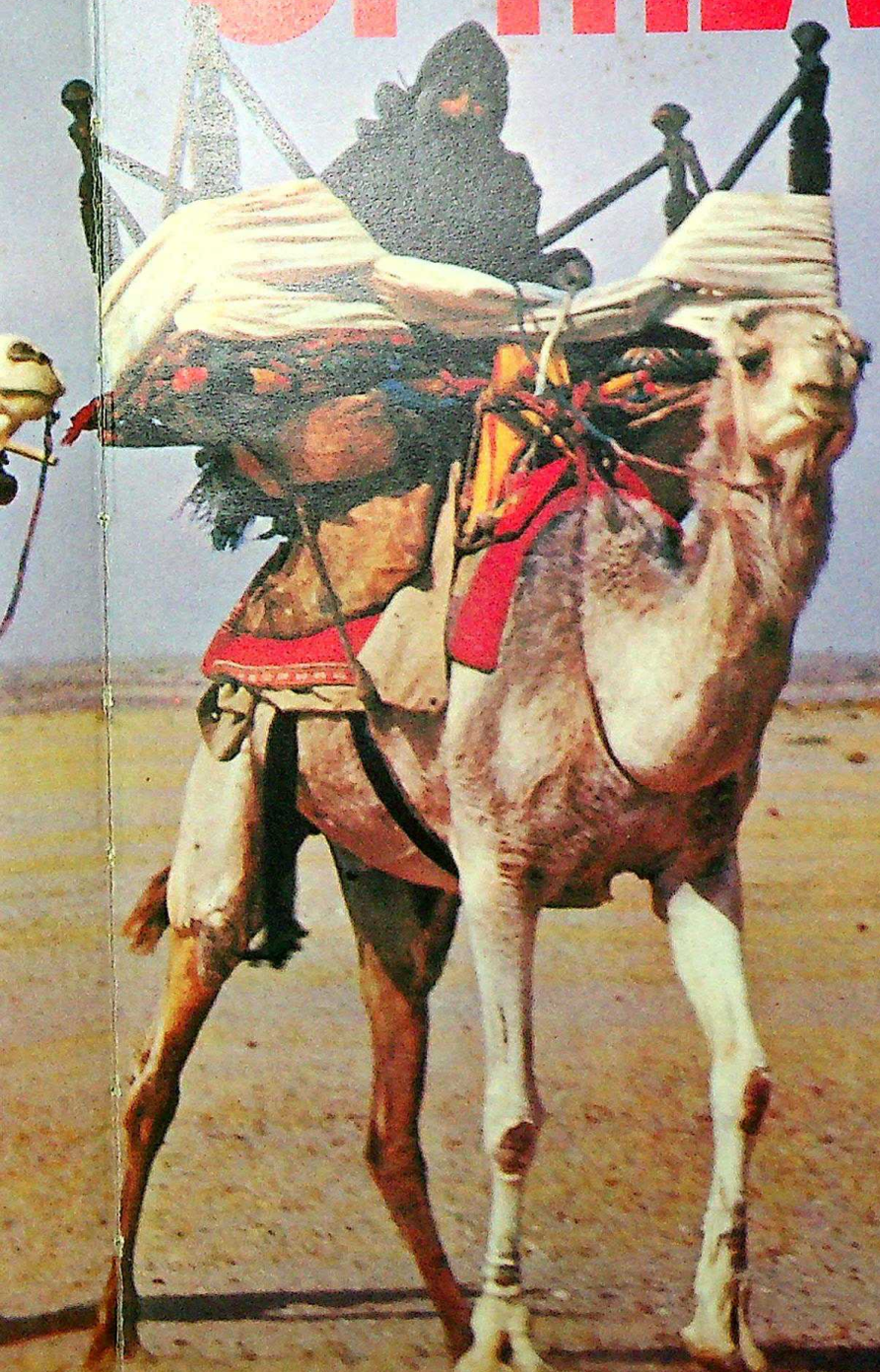

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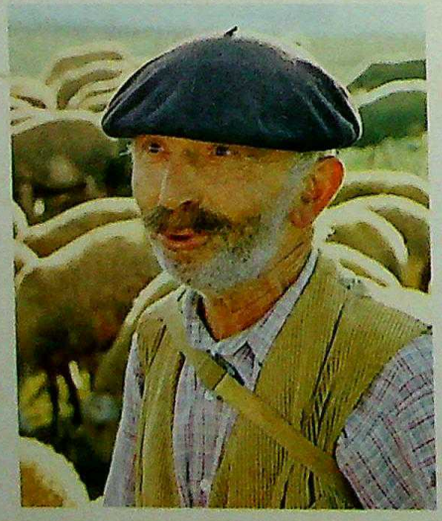

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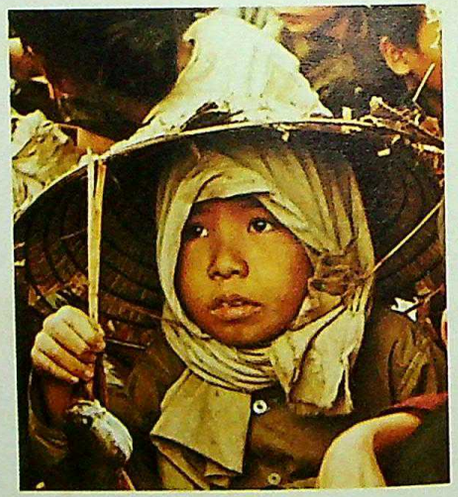

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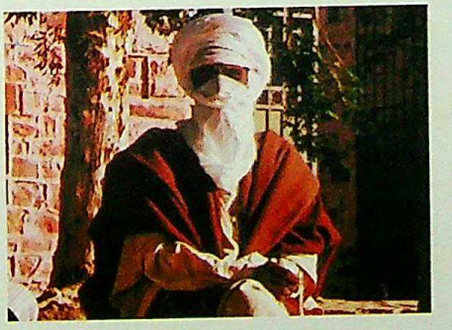

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FOREWORD

This is an encyclopedia of geography with a difference. It is not content with merely describing one country after another. It does this, of course, because geography is concerned with where things are and with the way in which mankind has organized the face of the earth into countries. But geography is more than describing man's homelands and recounting interesting facts and figures about them. It also looks at issues from a world viewpoint, explaining distributions and origins. For example, we may learn something about oil production by turning to the entries on Saudi Arabia, Venezuela and even Great Britain, but this wouldn't tell us very much about one of the most vital topics of today. Geographers are interested in oil production as a whole–how oil is formed, where it is found, and what it contributes to world energy and power. In other words, an economic geographer's interest cuts across countries in order to understand his topic in depth.

The publishers of this book rightly believe that systematic topics must be dealt with first, before the various bits and pieces are put together again in a different way to build up pictures of individual countries. In an easy-to-understand text, attractively written and illustrated, the encyclopedia begins at the beginning with the entire earth,

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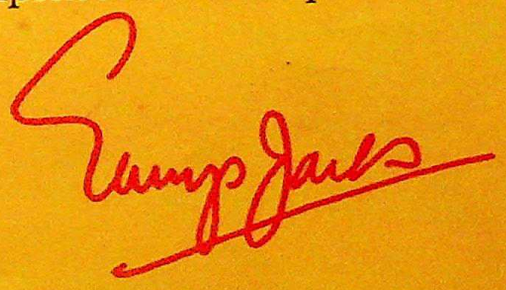
as a planet, which explains our day and night and the seasons, and gradually unravels the many aspects which together make the surface of the earth a home for man–land and sea, climate and weather, plants and animals. We are given glimpses of how different rock formations build up our varied landscapes, and even how the continents got their present shapes by the movements of the earth's crust. In the same way we must look at man on a world scale to understand how he became civilized, why he lives where he does, and the many ways in which he has come to terms with his habitat in order to produce a living. We see man as farmer, miner and manufacturer, and how he exchanges his produce through trade and links one country with another.

Finally, geography is essentially about things you can see–the great natural landscapes of the world, as well as those that man has transformed into farms and factories and cities, and the vast variety of the world's peoples. Half the encyclopedia is devoted to superb illustrations which bring the world to our feet, and which help us to visualize places we cannot visit but which are an essential part of our understanding of the complex relationship between man and his environment.



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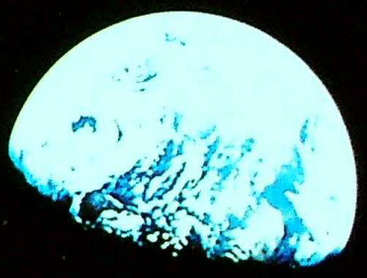
THE WORLD



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THE EARTH IN SPACE

The Earth we live on is a big round ball of rock floating in space. To us, it is the most important thing in the whole universe. The *universe* is everything that exists – the Earth, the Moon, the Sun, the stars and space.

Because the Earth is so important to us, people once believed that it was the centre of the universe. They thought that the Sun and the other bodies in the universe circled around the Earth. And this certainly appears to be the case at first sight. The Sun arcs across the sky during the day. And so do the Moon and stars during the night. Most of the stars stay in fixed positions. But a few appear to wander. They are therefore called *planets*, meaning 'wanderers'.

We now know, however, that it is the Earth which circles around the Sun and not the other way around. It is simply another planet. Together, the Earth and eight other planets circle around the Sun in space. They form the main part of the Sun's family, or *solar system*. Some planets have smaller bodies circling around them. The Earth, for example, has the Moon. Countless smaller bodies also belong to the solar system. They are really nothing more than chunks of rock and ice. We see some of them as meteors, or shooting stars, and as comets.

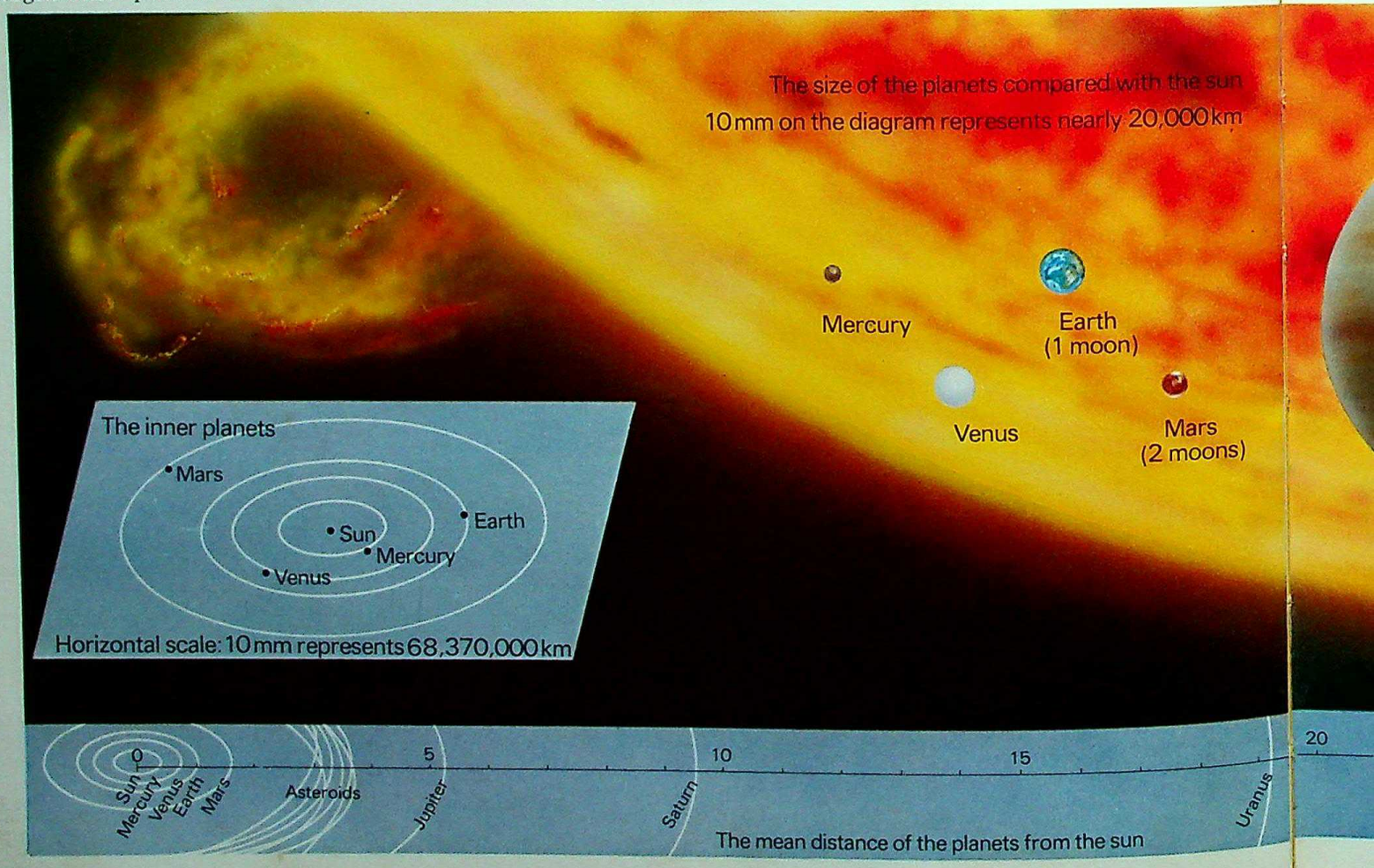
The Planets

The planets circle endlessly around the Sun and at different distances from it. The planet closest to the Sun is Mercury. Next comes Venus and then the Earth. The Earth lies about 150 million kilometres (93 million miles) from the Sun. Going out from the Earth the planets are Mars, Jupiter, Saturn, Uranus, Neptune and Pluto. Pluto lies nearly 40 times farther away from the Sun than the Earth does.

Mercury, Venus, Earth and Mars lie relatively close together. Then comes a big gap until Jupiter. Within this gap circle thousands of smaller bodies called *minor planets* or *asteroids*.

The Earth measures about 12,750 km (7,920 miles) across. It is bigger than Mercury, Pluto, Mars and Venus. But it is very much smaller than the other planets. The largest one, Jupiter, is 11 times bigger than the Earth. The asteroids are very small indeed. Even the largest, Ceres, is only about 760 km (470 miles) across.

The diagram below gives an idea of the massive scale of the solar system. The main part shows the relative sizes of the planets against the curve of the Sun. Even the largest planet, Jupiter (diameter 143,000 km) is minute compared with the Sun (diameter 1,392,000 km). The bottom part of the diagram shows the distances of the planets from the Sun. (1 astronomical unit is the distance from the Earth to the Sun.)



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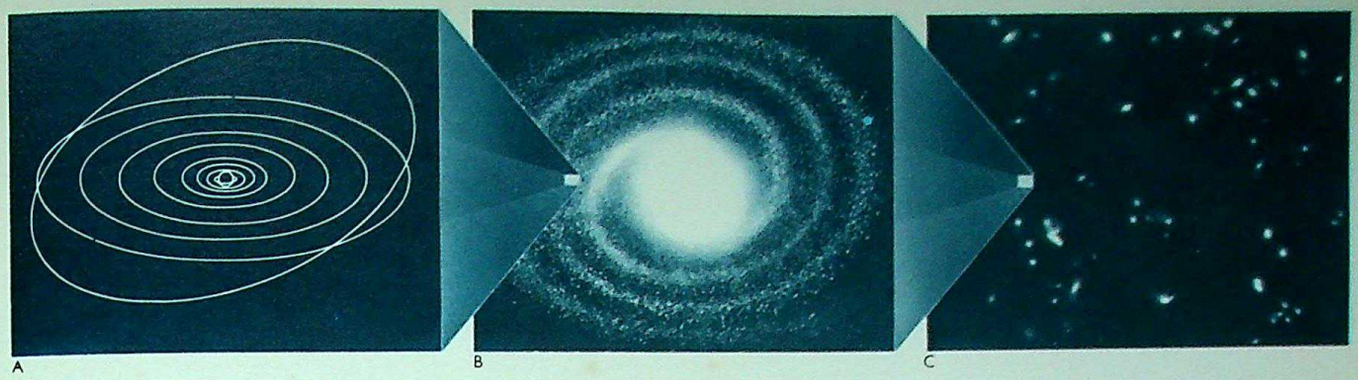
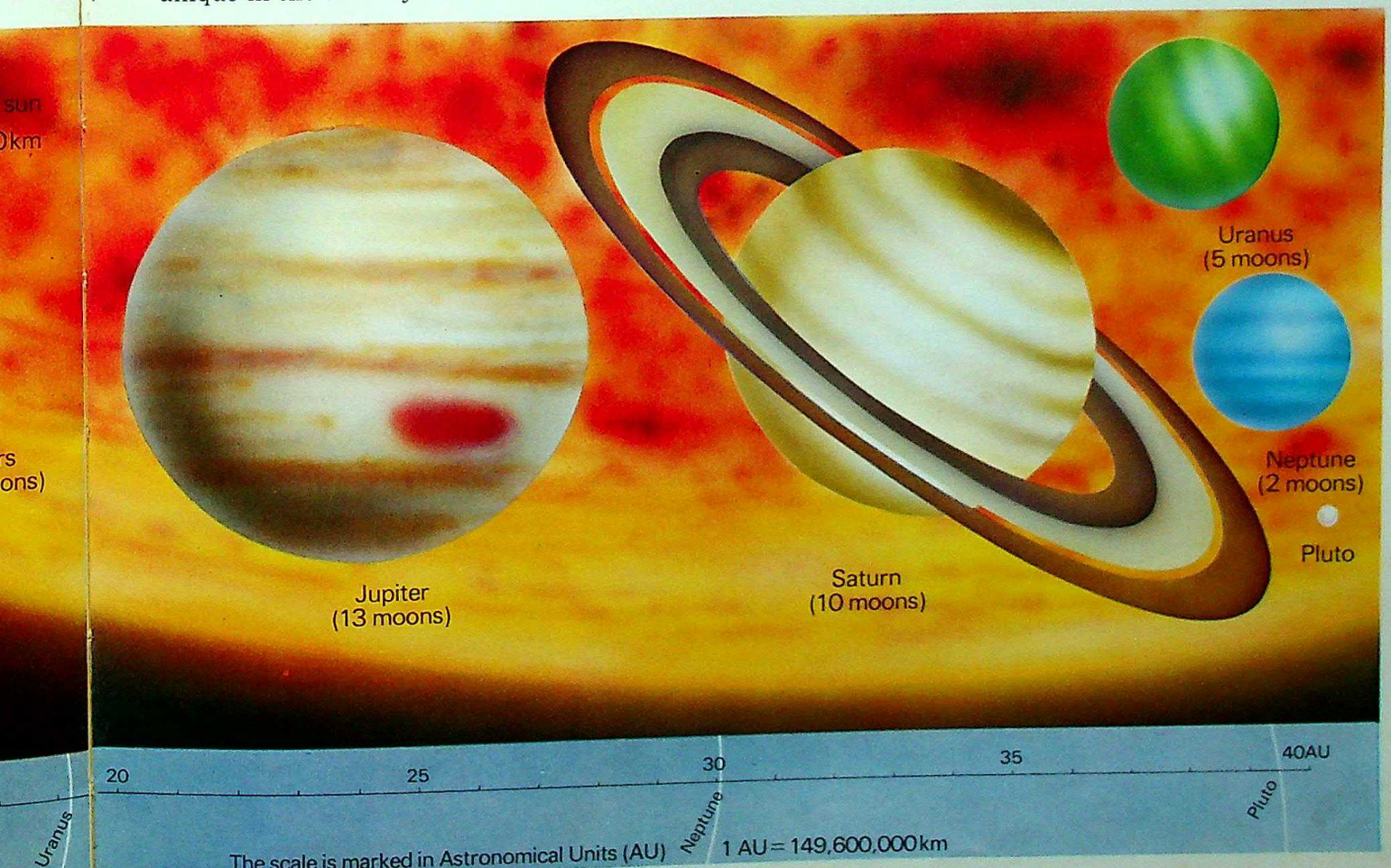


Big though it is, the solar system is a mere speck in the universe. It lies on one of the spiral arms of our home galaxy, which is one of millions in the universe.

Seen from space, the Earth looks different from all the other planets. It is surrounded with a soft blue glow. Its surface is made up of brown regions surrounded by deep blue. Some parts are covered by brilliant white swirls. The soft blue glow is caused by white sunlight being split up by the *atmosphere*. This is the layer of air that surrounds the Earth. The white swirls are clouds in the atmosphere. The brown regions are dry land; the dark blue regions are seas.

What cannot be seen from space is the thing that makes the Earth unique in the solar system – life. On the land and within the seas live thousands upon thousands of different *species* (kinds) of plants and animals. Where the Earth is in the solar system, conditions are just right for living things to thrive. In particular the Earth receives just the right amount of heat from the Sun. The planets closer to the Sun are too hot for life as we know it to exist. On Mercury and Venus, for example, the temperature may rise to over 400°C. The planets farther from the Sun are too cold for life to exist. On the distant outer planets the temperature must be more than 200°C below zero.

Mercury, Venus, Mars and Pluto are rocky planets like the Earth. The surface of Mercury is dry and barren. It is covered with holes, or *craters*, where rocks from space have hit it. Venus is a mystery planet because it is always covered with thick cloud. Only recently have we been able to see beneath the cloud. The surface is strewn with dust and rocks. Apart from the



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The giant planet Jupiter, snapped by the US space probe Pioneer 10 on its epic fly-by in 1973.

Sun and the Moon, Venus is the brightest object in the sky. Mars is dry and barren and covered in craters. It has a very thin atmosphere, in which dust storms can occur. It is called the Red Planet because it has a reddish appearance in the sky. Pluto is so far away that little is known about it, except that it must be very, very cold.

The remaining four planets differ from the others because they are made up mainly of gas. But they might have a rocky centre. Jupiter has belts of clouds around it and a mysterious Red Spot. This is thought to be the centre of a huge storm that has been raging for hundreds of years. Saturn is the most beautiful of the planets because it is surrounded by a system of three flat rings. Like Mars and Jupiter, Saturn can easily be seen in the night sky with the naked eye. The planet Uranus, however, can scarcely ever be seen without a telescope. Neptune can be seen only with a telescope. Uranus and Neptune are nearly identical in size and appearance. Little is known about them because they are too far away to be seen clearly, even with a telescope.

Astronomers – the scientists who study the heavenly bodies – have learned much about the other planets in recent years. They have built very large and powerful telescopes. And they have sent spacecraft to photograph some of the planets at close quarters. Some spacecraft have even landed on Mars and Venus and sent back information about their surface.

The Moon

The silvery Moon is our closest neighbour in space. It circles round the Earth about 390,000 km (240,000 miles) away. It is the Earth's *satellite*. The Earth has many artificial satellites, too. They are the spacecraft put there by scientists. Astronomers know more about the Moon than about any other body in the heavens because men have actually been there. Between 1969 and 1972 twelve American astronauts from Apollo spacecraft explored the Moon's surface on foot. They carried out experiments and set up scientific stations. They also brought back samples of Moon rock and soil.

The Moon is a rocky body only about a quarter the size of the Earth. It measures about 3,480 km (2,160 miles) across. There is no air, no water and no life on the Moon. It is silent because there is no air to carry any sound. Without a 'blanket' of air, the days are very hot and the nights are deathly cold. Much of the Moon's surface is covered with high mountains and craters. But there are also large areas that are flat and low-lying. They are called *maria*, meaning 'seas', because early astronomers thought that they might be watery seas. The dark areas of the Moon we can see with the naked eye are mare regions.

Many of the other planets have satellites, or moons, too. Mars and Neptune have two each; Uranus has five; Saturn has ten. And Jupiter has no less than fourteen. The last one was discovered as recently as 1975. One of Jupiter's satellites, called Ganymede, is bigger than the planet Mercury.

The Sun and the Stars

Of all the heavenly bodies, the Sun is the most important to us. It brings us light, heat and life. Without the Sun, the Earth would be a dark, cold and dead ball of rock. Sunlight not only allows us to see, it also gives green plants the energy they need to make food. And we and other animals depend on plants for food.

The Sun is not like the other bodies in the solar system. It is made up of very hot glowing gas, mainly hydrogen. It is a star, much like the many other stars in the sky. It appears bigger, hotter and brighter than the other stars because it is very much nearer. The next nearest star to us is more than 250,000 times farther away than the Sun. It lies at a distance of about 40 million million kilometres (25 million million miles). It is called Proxima Centauri.

The temperature of the Sun's surface is about 6000°C. This is about five times hotter than red-hot steel. In the middle of the Sun the temperature rises to about 15,000,000°C. At such a temperature atoms of hydrogen combine together to form atoms of another gas, called helium. An *atom* is the smallest part of a thing you can get. When hydrogen atoms combine, large amounts of energy

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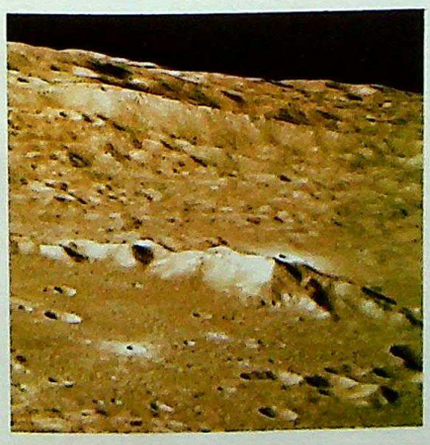
Above: A view of the Moon taken by one of the Apollo 8 astronauts who circumnavigated the Moon in 1968. It shows mostly the hidden side of the Moon. The circular mare, or 'sea', visible is the Sea of Crises.
Below: A close-up of the lunar surface, showing the wealth of new and old craters.



are given out. The Sun gives out this energy as light and heat and other kinds of radiation that we cannot see or feel.

The Sun is not a very big star. But it is very much bigger than the Earth is. It has a diameter of about 1,392,000 km (865,000 miles), which is nearly 110 times that of the Earth. If the Sun were the size of a beach ball, the Earth would be the size of a small pea. Yet some stars are more than 3,000 times the size of the Sun! They are called *supergiants*. By contrast there are other stars that are not much bigger than the Earth. They are called *white dwarfs*. They are made up of material so dense that a teaspoonful would weigh a tonne or more.

When we look up at the night sky, we can see that many of the bright stars appear to form patterns. These patterns do not change from year to year. We call them *constellations*. Ancient astronomers named the constellations after animals, heroes and things that appeared in their legends. One of the easiest constellations to recognize is the Great Bear (*Ursa Major* in Latin). Part of this constellation forms The Plough. Other well-known constellations are the Swan (*Cygnus*), the Lion (*Leo*), the Flying Horse (*Pegasus*) and the Big Dog (*Canis Major*). The Big Dog contains the star Sirius, or the Dog Star. It is the brightest star in the sky.

The stars in the constellation may look as though they are grouped together in space. But usually they are not. They lie at different distances from us. Some stars do group together, however. Sometimes two or three group together to form *double stars* and *triple stars*. Sometimes hundreds and even thousands of stars form

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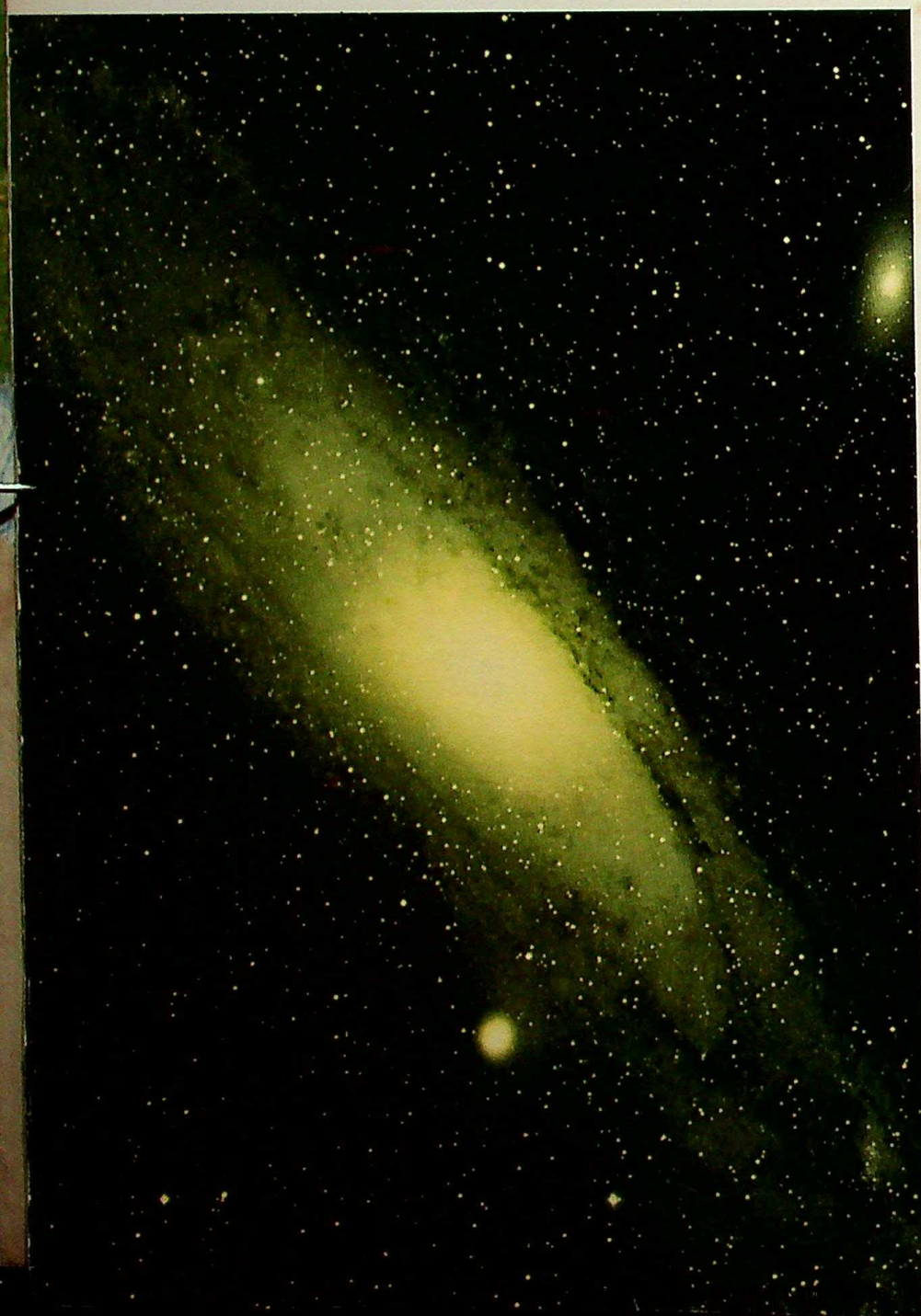
giant *clusters*. On a much larger scale hundreds of millions of stars group together to form a great star island in space. We call this a *galaxy*. The Sun belongs to a galaxy we call the Milky Way. It is thought to be like a flat disc with a bulge at the middle, and with spiral arms coming from it. And it spins, much like a Catherine wheel. There are many other galaxies in the universe, each of them containing something like a hundred million stars. Astronomers have photographed hundreds of these galaxies in their powerful telescopes. Some lie so far away that their light takes thousands of millions of years to reach us. And light travels 300,000 km (186,000 miles) every second!



M31, known as the spiral galaxy in Andromeda. If we could photograph the Milky Way (our own galaxy) from a great enough distance, it would look something like this. It is thought that M31 contains about 100,000 million stars.

The Earth in Motion

Everything in the universe is moving. Moons travel around their planets. Planets travel around their stars. Stars whirl around their galaxies. And the galaxies rush headlong through space. The Moon travels once around the Earth in about a *month* (coming from Moon-th). The Earth travels once around the Sun in a *year*.

In addition to this, the heavenly bodies spin round and round like a top. The Earth, the Moon, the Sun and the stars are all spinning. This spinning gives us our basic unit of time – the *solar day*, or the day according to the Sun. When a place on the Earth spins into the Sun's light, it is day-time. When it spins out of the Sun's light, it is night-time. There are $365\frac{1}{4}$ solar days in the year. In our calendar we allow for only 365 days in the year. Therefore we add on an extra day every fourth year to make good the error. This fourth year is called a *leap year*.

We can imagine that the Earth spins about a line through its centre. We call this the Earth's *axis*. This imaginary axis meets the Earth's surface at two points, called the *Poles*. When we make a globe to represent the Earth, we usually call the upper pole the North Pole, and the lower one the South Pole. We refer to the upper half of the globe as the *Northern Hemisphere*, and the lower half as the *Southern Hemisphere*. The imaginary centre line between the two is known as the *Equator*.

In order to locate a point on the globe, we draw in other imaginary lines. We draw lines around the globe parallel to the Equator. These are called *parallels of latitude*. They are numbered from 0–90 degrees north and south of the Equator. We also draw a series of lines around the globe, passing through the poles. These are called *lines*, or *meridians of longitude*. They are numbered 0–180 degrees East (to the right) or West (to the left) of the meridian passing through Greenwich, where there was once a famous observatory. By referring to these parallels and lines, we can locate any place on the globe. Salisbury, England, for example, is located at about 51 degrees North and 2 degrees West. (More information about latitude and longitude is given on page 14).

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THE LAND

From space the Earth appears to be a smooth, round ball. Actually it is not quite round. It bulges slightly at the Equator, and it is slightly flattened at the Poles. This is a result of the Earth's rotation on its axis. The diameter of the Earth along the Equator is 12,756 km (7,926 miles). The diameter through the poles is 42 km (26 miles) less.

The greater part (more than two-thirds) of the Earth's surface is covered by water. The largest stretches of water are the *seas* and *oceans*. The main land masses are the seven *continents*. The other land masses are *islands*. The continents in order of size are Asia, Africa, North America, South America, Antarctica, Europe, and Australia. Often Europe and Asia are considered together as a single continent, Eurasia.

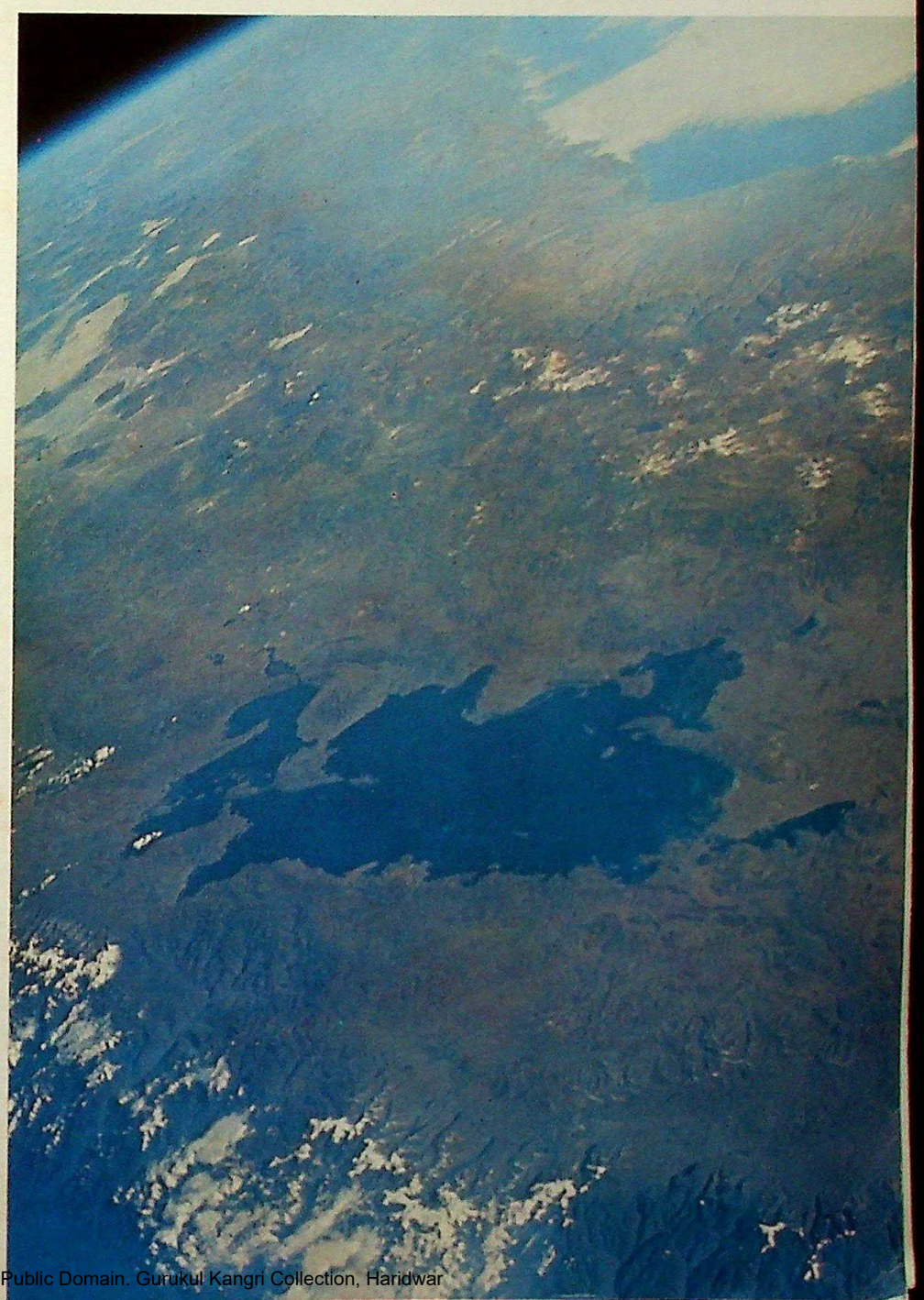
Many islands lie close to a continent on the *continental shelf*. This is a continuation of the continental land mass which lies beneath sea level. The British Isles and Newfoundland are examples of continental islands. They are separated from the mainland by shallow seas – for example, the North Sea. Other islands lie in the middle of the ocean. Many are the tops of submerged mountain ranges. Tristan da Cunha, for example, lies on the Mid-Atlantic Ridge. Some oceanic islands are formed from coral. Coral is made up of the limestone skeletons of tiny sea creatures called polyps. There are many coral islands in the South Pacific.

When you look at a globe of the Earth, you notice several interesting things. For example, the land and water are not spread out evenly over the Earth's surface. Most of the land is located in the Northern Hemisphere. Where there is land on one side of the globe, there is usually water on the opposite side. Another curious point is that many of the land masses are roughly triangular in shape. North and South America are; so are Africa and India. All this is a consequence of *plate drift* (see page 57).

The nature of the land surface varies greatly from place to place. In some regions there are high mountains, cleft by steep valleys. In others there are rolling hills, through which rivers wind. Some regions are barren, waterless deserts in which nothing will grow. Others are fertile flat plains, where farming flourishes.

The highest point on land is Mount Everest in the Himalayas, with a height of 8,848 metres (29,028 feet) above sea level. The lowest point on land is the shore of the Dead Sea, which is 393 metres (1,290 feet) below sea level. To us it appears that the Earth's surface is very rough. But when we consider the great size of the Earth, the surface is really very smooth. We can liken it to the slight wrinkles on the surface of an orange.

Satellite photographs have proved very valuable to geographers. This one shows the South American Andes and the Bolivian altiplano beyond.



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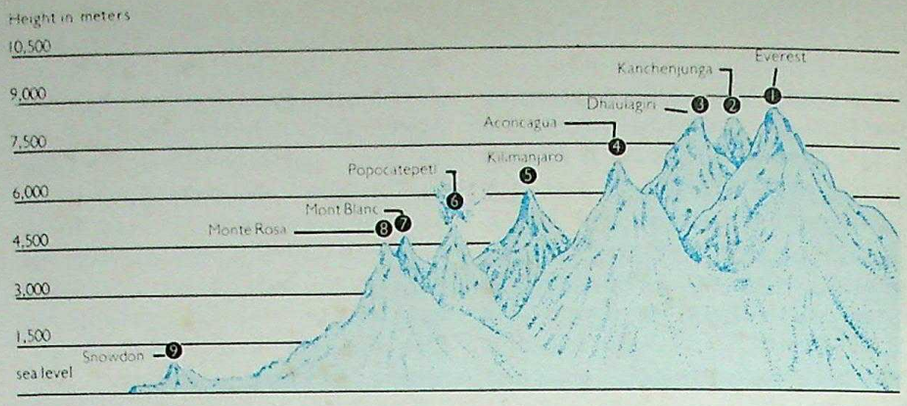
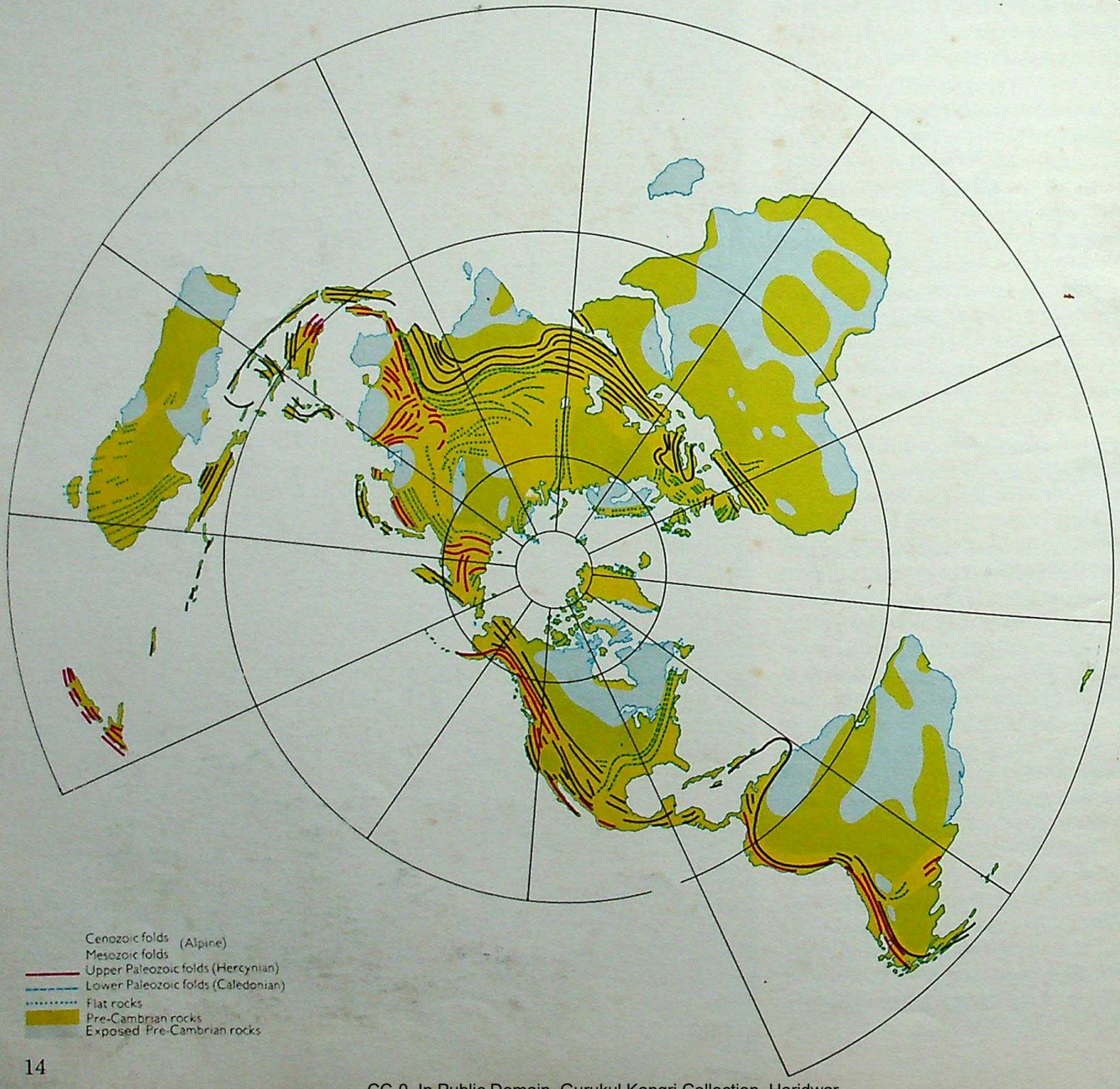
In general we can consider the land as being made up of mountains, shields, plateaux and plains. Two main things have given rise to such features. One is movement of the Earth's crust. The other is *erosion* (wearing away) by the weather, water, ice, wind and other agents. Crustal movements and erosion are still at work today, changing the Earth's surface slowly but surely.



The Mountains

Mountains occur by themselves in certain parts of the world. Kilimanjaro (5,895 metres, 19,340 feet), the highest mountain in Africa, is fairly isolated. Most isolated peaks are, like Kilimanjaro, of volcanic origin – they were once volcanoes. Usually, however, mountains form part of a mountain range. Mount Godwin Austen, or K2 (8,610 metres, 28,250 feet) is a peak in the Karakoram Range. This is one of several ranges that make up the vast Himalaya mountain system in Southern Asia.

Above: Some of the highest mountains of the world compared in height.
Below: Major fold mountain belts of the world, and their ages.



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The Himalaya system is part of a vast belt of mountains that spreads right across Asia and Europe. The belt extends westwards from the Himalayas to the Alps, and also includes the Pyrenees, the Apennines, Carpathians, Caucasus, and Atlas mountains. It is called the *Alpide belt.* The mountains are relatively young – less than 50 million years old. They are known as *fold* mountains. They were formed as a result of movements of the Earth's crust.

The Earth's crust is believed to be made up of several blocks, or *plates.* These plates are continually moving in relation to one another (see page 57). When two plates come together, one plate rides up over the other. Land on the edge of the upper plate is compressed, and thrust up into great parallel folds. The arched part of a fold is known as an *anticline.* The trough-shaped part is called a *syncline.*

Another major system of young fold mountains girdles the Pacific Ocean. It is called the *circum-Pacific belt.* It includes the Andes of South America, the Rocky Mountains and Western Cordillera of North America, and mountains in Japan, the Philippines and New Zealand.

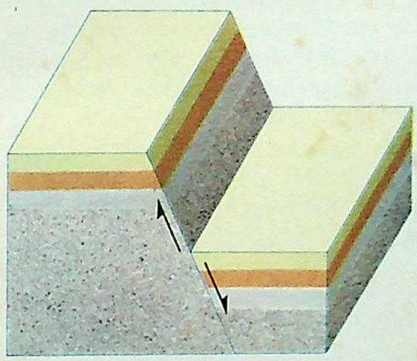
Being relatively young, these fold mountains are very high and very rugged. They are too young to have been worn away much by erosion. They are regions of great earthquake and volcanic activity (see page 55). Mountain building, in fact, is still proceeding in these regions.

Many older fold mountain systems are also to be found throughout the world. About 300 million years ago were formed the Appalachians, the Urals, the Great Dividing Range of Australia, and the Pennines. The highlands of Scotland and Scandinavia were formed some 100 million years earlier. All these mountains are much lower and smoother than the young fold mountains. They have been subjected to hundreds of millions of years of erosion by rain, frost, ice and wind.

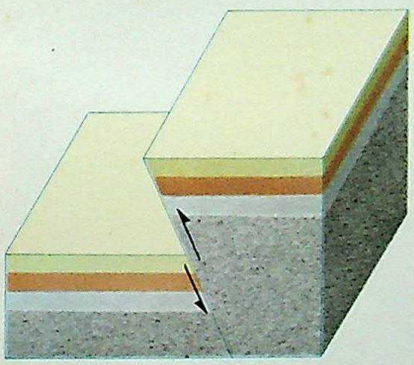
Block Mountains and Rift Valleys

Some mountains are formed as a result of vertical movements in the Earth's crust. This occurs along cracks, or *faults.* Sometimes a huge block of crust tilts upwards along a fault to form what is called a *block mountain.* The Sierra Nevada range in eastern California is an excellent example of a block mountain. It is some 400 km (250 miles) long and 80 km (50 miles) wide. It includes Mount Whitney (4,418 metres, 14,494 feet), the highest peak in the United States outside Alaska.

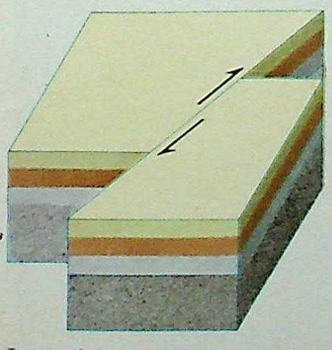
In places parallel faults occur close to each other in the Earth's crust. Sometimes the block of land between them drops, and a *rift valley* is formed. The best-known rift valley runs through East Africa. It runs for more than 4,800 km (3,000 miles) from Mozambique in the South, through eastern and northern Africa, to Syria in the North. It contains the Red Sea and many of Africa's great lakes.



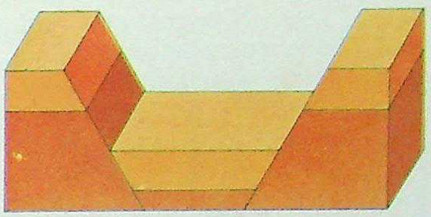
Normal fault



Reverse fault



Transverse fault



Here and there over the Earth's surface, lines of weaknesses occur in the crust. Sometimes blocks of the crust move relative to one another along these lines, causing a geological fault. The blocks may move vertically or horizontally. The diagrams left show three main kinds of fault. Where two parallel faults occur, the piece of crust in between may fall, creating a rift valley (above).
Below: The Earth's surface features reflect the underlying geological structure.

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This mountain slope consists of bands of hard and soft rock. The soft rock has been eroded more than the hard, giving rise to a very uneven surface.

Shield Regions

Large areas of the Earth's surface have not suffered any disturbance by mountain building for at least 600 million years. They are made up of ancient rock, and are not very high. They are known as *shield regions*, because some of them have the shape of a shield. In northern Europe there is the *Baltic shield* which covers much of Scandinavia and includes part of the Baltic Sea. In the north-east of North America is the very large *Canadian shield*. Both the Baltic and Canadian shields slope gradually to the south, and disappear below younger rocks. Both are rich mining regions.

Plateaux

In many parts of the world, there are large stretches of relatively flat highland regions. They are called *plateaux* or *tablelands*. The plateaux fall away steeply at the sides to lower ground. Rivers flow swiftly across the plateaux and carve deep channels. They often plunge over the edges at waterfalls. Plateaux are composed of fairly ancient rocks, and have not been involved in mountain-building for a very long time. They have been worn flat by prolonged erosion.

Nearly the whole of Africa is plateau land, which averages between 900–1500 metres (about 3,000–5,000 feet) above sea level. The great African rivers – Nile, Niger, Zaire (Congo), and Zambezi – drop over the edges of the plateaux in spectacular waterfalls. Such features provided a barrier which prevented exploration of the interior of Africa for a great many years. Today they tend to hinder commercial development of the interior.

There are several other large plateau regions. In Asia are the Tibetan plateau, the Deccan (in India), and the Syrian-Arabian plateau. The bleak Tibetan plateau is some 4,900 metres (16,000 feet) above sea level, and is bordered by the towering Himalayas. In South America the Brazilian and Guiana Highlands are plateaux. A huge plateau covers western Australia.

The Plains

In contrast to the rocky highlands and high plateaux, many areas of the world are flat and low-lying. These regions are called *plains* or *lowlands*. Plains are often to be found in the heart of the continents. The Central European Plain and the Central Plains of North America cover enormous areas. These plains are formed of flat bedded rocks that have been little disturbed by mountain building. The Central Australian Plain is like this, too.

Other great plains have been formed by the building up of silt and mud carried and deposited by rivers. They are called *alluvial plains*. The Plain of North China is an alluvial plain of the Hwang River. The alluvial Indo-Gangetic Plain in northern India is dominated by the mighty Ganges. Large alluvial plains occur in South America in the region of the Amazon and the Paraná-Paraguay rivers.

The plains regions are in general highly populated and are major farming areas. This is particularly true of the great alluvial plains, which have very rich soil. Where coal, oil and iron ore are found nearby, great industrial centres have sprung up on the plains. Movement across the plains is easy since there are few natural obstacles. Most rivers are slow-running and easily navigable.

The Bolivian altiplano, a high plain formed from alluvium carried down from the Andes.

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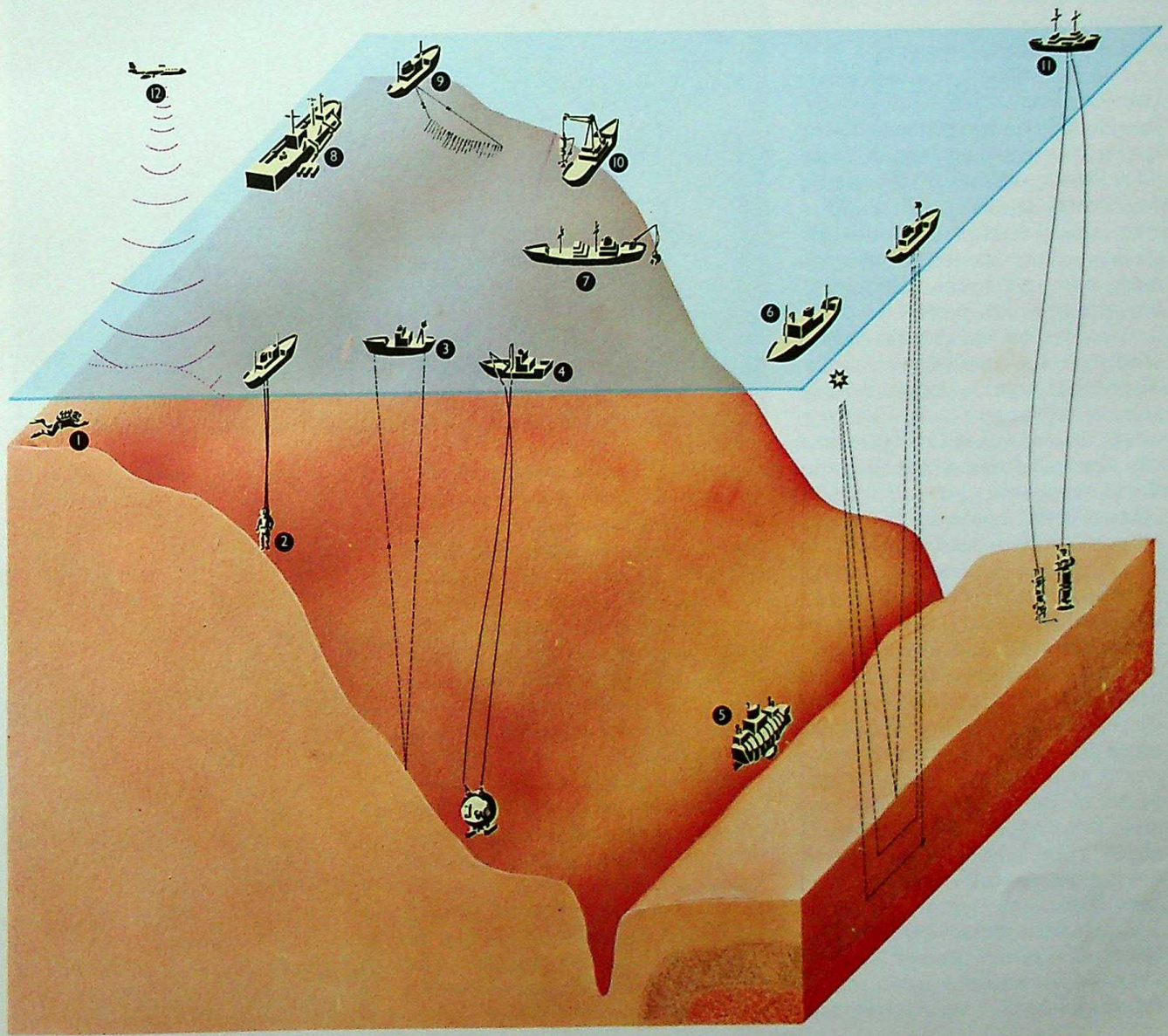
THE SEAS AND OCEANS

More than two-thirds of the Earth's surface is covered by water. This water forms what is often called the *world ocean*. We can divide up the world ocean into several separate bodies of water, which of course are all connected. The main bodies of water are the Pacific, Atlantic, Indian and Arctic oceans. Each of these oceans includes smaller bodies of water at their edges, which may be partly landlocked. They may be called seas, bays, gulfs, bights, channels or straits.

The water of the seas and oceans is not fresh like that in rivers and lakes on land. It is salty. It contains about 35 parts of various chemical salts in 1,000 parts of water. Most is common table salt, which is properly called sodium chloride. Other salts include magnesium chloride and potassium bromide. The salts got into the ocean through the rivers. River water washes salts from the rocks and soil as it passes over them.

Study of the oceans is known as *oceanography*. It is very important for many reasons. For one thing the oceans are a major source of food. They teem with an enormous variety of fish and shellfish, which form an important part of Man's diet. The world's largest ever animal, the whale, lives in the oceans. So do seals and porpoises. These animals are all warm-blooded mammals. But one of the most important life forms in the sea is plankton. Plankton consists of tiny floating plants and animals which drift with the ocean currents. They

Many methods may be used in oceanography to study the ocean floor, depending largely on the depth of water. Frogmen (1), divers (2), and men in diving bells (4) and bathyscaphes (5) may descend to the seabed. The bed may be probed by echo sounding (3) and (9), seismic sounding (6), or photography (11). Samples can be obtained by grabs (7), dredgers (8) and drilling ships (10). The quickest method is magnetically, from the air (12).



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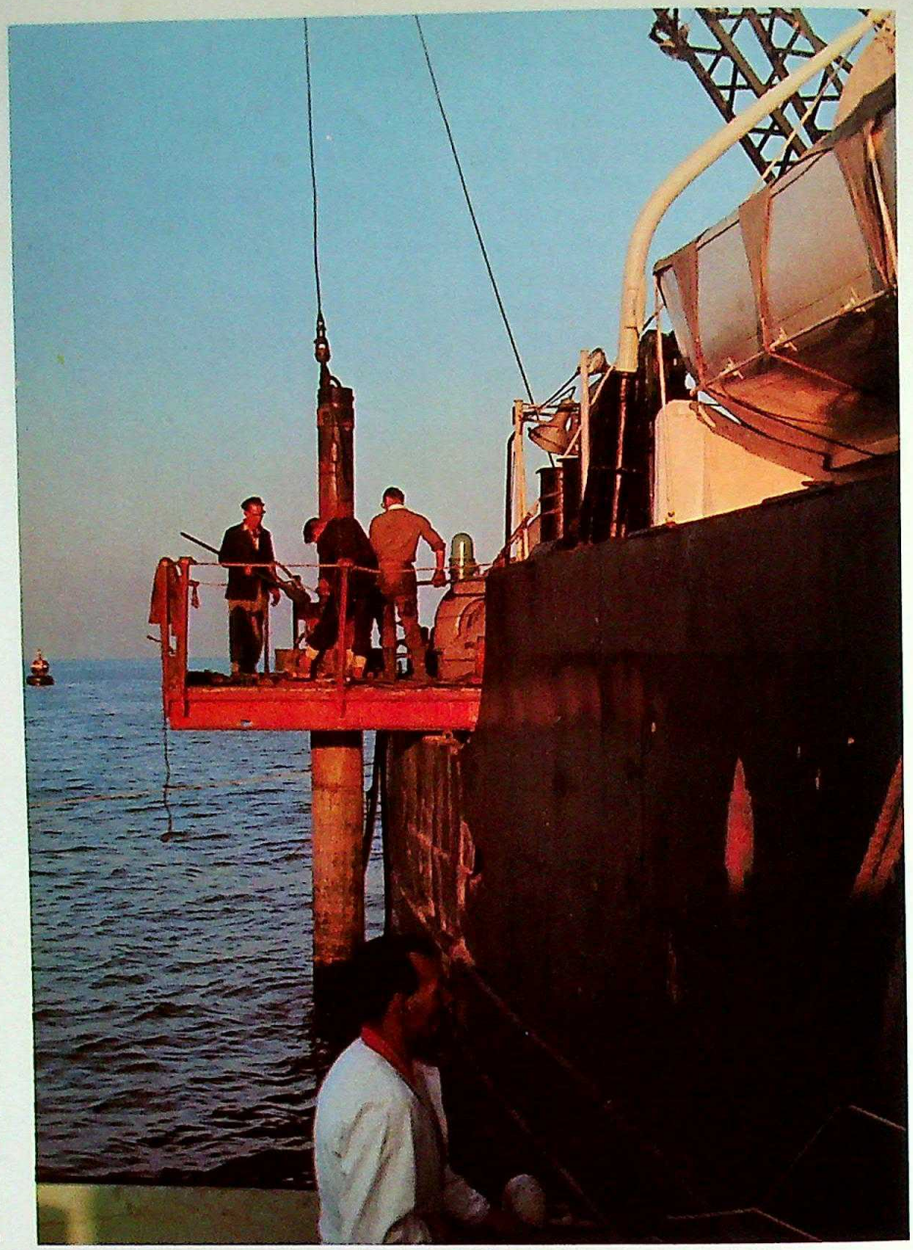
provide the basic food of many sea creatures.

The oceans have a profound effect on the weather and climate. Over the world as a whole they have a steadying influence. They change in temperature much more slowly than land does. Places near an ocean generally have milder winters and cooler summers than places inland at the same latitude. Oceans also influence the weather because their water evaporates, or changes into vapour. In the air the vapour cools, and changes back to water. It then falls back to the Earth as rain or snow.

The oceans also serve as a ready means of communication around the world. Ships still provide the cheapest way of transporting goods in bulk. Some of the world's greatest cities are trading ports which have grown up on the coasts of the great oceans.



Above: Oceanographers drilling the seabed to take core samples. These may reveal important facts about the Earth's crust.
Top right: Research submarines, or submersibles, like these help scientists explore the oceans.
Right: Holidaymakers exploring the Great Barrier Reef, off the east coast of Australia. A dazzling underwater garden, it teems with exotic marine life.

The Pacific

The Pacific Ocean is the largest ocean, which covers about 165,000,000 square kilometres (64,000,000 square miles). This is more than a third of the world's surface. The Pacific separates Asia and Australia from the Americas. At its widest point it is some 18,000 km (11,000 miles) across. To the north it is connected to the Arctic Ocean by the narrow Bering Strait. To the south it is open and merges into the waters of the Antarctic, the southern ocean.

The Pacific contains the deepest point known on Earth. This is Challenger Deep, near the Island of Guam, with a depth of 11,033 metres (36,198 feet). If you dropped a lead ball in the sea at this point, it would take over an hour to reach the bottom. The pressure there is more than one thousand times the pressure of the atmosphere at sea level. The average depth of the ocean, however, is only about 4,300 metres (14,000 feet). This is about the same average depth as the Atlantic and Indian oceans.

Challenger Deep lies in the Mariana Trench, one of several long *deeps* on the ocean floor. Other deep trenches include the Atacama Trench off Chile, the Aleutian Trench off the Aleutian Islands, and the Japanese-Kuril Trench off Japan. Trenches mark regions where a block, or *plate*, of the Earth's crust is sinking. Another plate is riding up on it. This gives rise to high mountains on nearby land, such as the Andes. These regions are very prone to earthquake and volcanic activity (see page 58).

Most of the Pacific ocean floor, however, is a relatively flat, deep-sea plain. In places, though, ridges rise from the plain. The volcanic Hawaiian islands are situated on such a ridge. Scattered volcanic and coral islands occur in other parts of the Pacific, particularly in the south-west. In all, they number over 30,000.

The Atlantic Ocean

The Atlantic Ocean separates Europe and Africa from the American continents. It has only about half the area of the Pacific. But it is the most important of the oceans because most of the world's leading industrial cities are located along its coasts. The Atlantic has the shape of an S, and its

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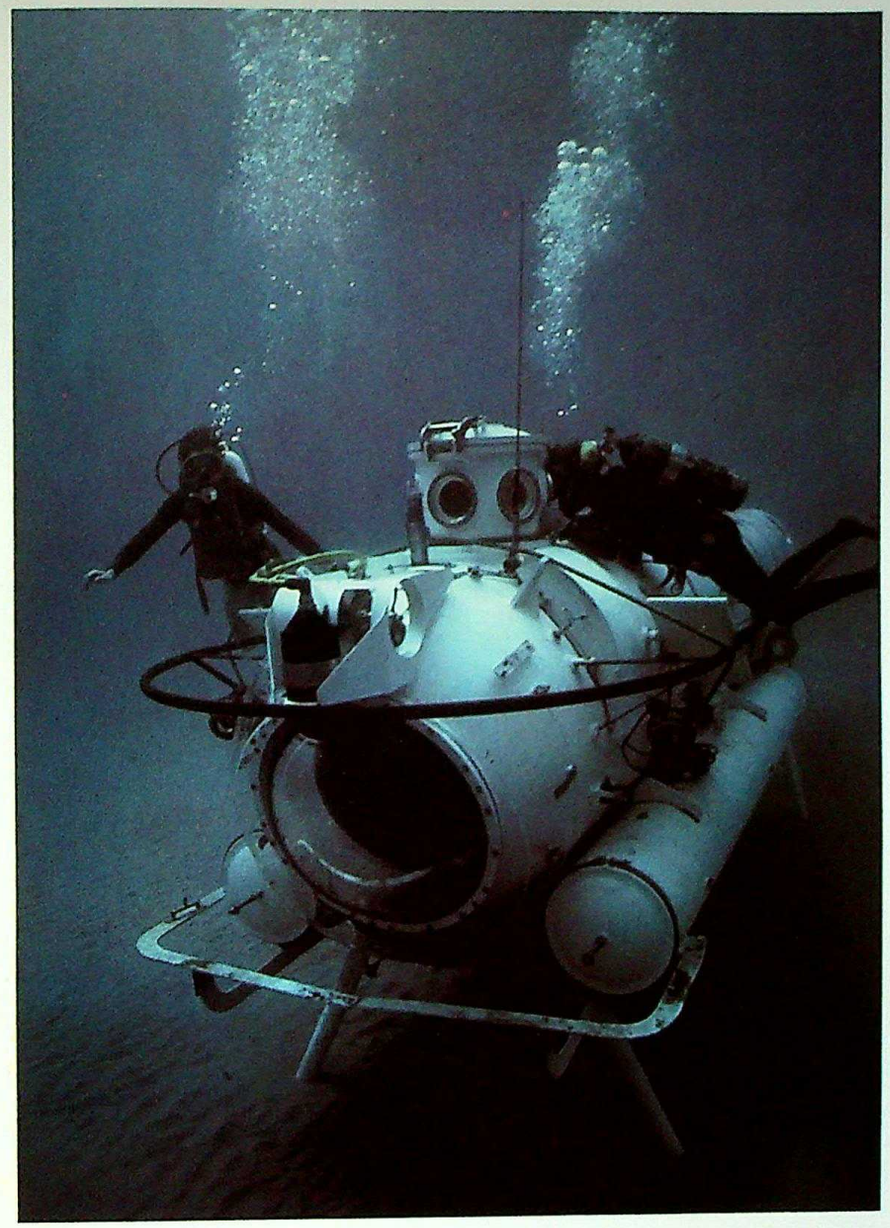

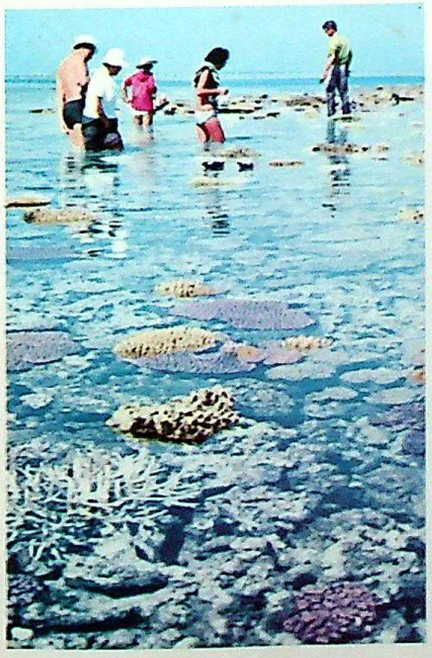

western and eastern shores are remarkably parallel. According to the theory of continental drift, the Americas were in fact joined to Europe and Africa millions of years ago.

At the edges, the Atlantic is shallow over the gently sloping *continental shelves*. These are regions that are a continuation of the continental land masses. Many islands are located on the broad continental shelves. They include the British Isles, Newfoundland and Tierra del Fuego. From the continental shelves, the Atlantic floor plunges down a steeper *continental slope* to a deep-sea plain. The Atlantic therefore differs from the Pacific, which is ringed by steeply rising mountains and volcanic islands. It is also different because it contains hardly any deep trenches.

The most prominent feature of the Atlantic floor is the S-shaped Mid-Atlantic Ridge, which runs along the centre. According to the latest theories, this ridge is a region where new crust is forming at the edges of two plates. In places the ridge rises above sea level, and islands occur. In the North Atlantic are Iceland and the Azores. In the South Atlantic are Ascension Island and Tristan da Cunha.

Indian and Arctic Oceans

The Indian Ocean is a little smaller than the Atlantic. It is bounded by land to the north and merges with the waters of Antarctica in the south. Its floor is a deep-sea plain divided by broad ridges. In the centre the ridge widens into a large plateau. The ridges carry small volcanic islands like Mauritius and coral islands like the Seychelles. The larger islands of Madagascar, Sri Lanka (Ceylon) and Indonesian islands such as Java lie on broad continental shelves. The Indian Ocean contains only one deep, the Sunda Trench off Java. This region is often racked by earthquakes and is volcanically active.

The Arctic Ocean is the smallest of the major oceans, with an area of only about 14 million square kilometres. It occupies a relatively shallow basin around the North Pole. Its average depth is little more than 1,500 metres (5,000 feet). It is bounded by North America and Eurasia, which have broad continental shelves. From these, many islands rise. There is no land mass at the North Pole as there is at the South Pole. But the region around the North Pole is permanently frozen with ice several metres thick.

Continental Seas

These are seas which are almost or completely enclosed, or landlocked. They differ in many ways from the great oceans and from the seas which form part of the oceans. For one thing they are almost always tideless. They seldom have any strong currents.

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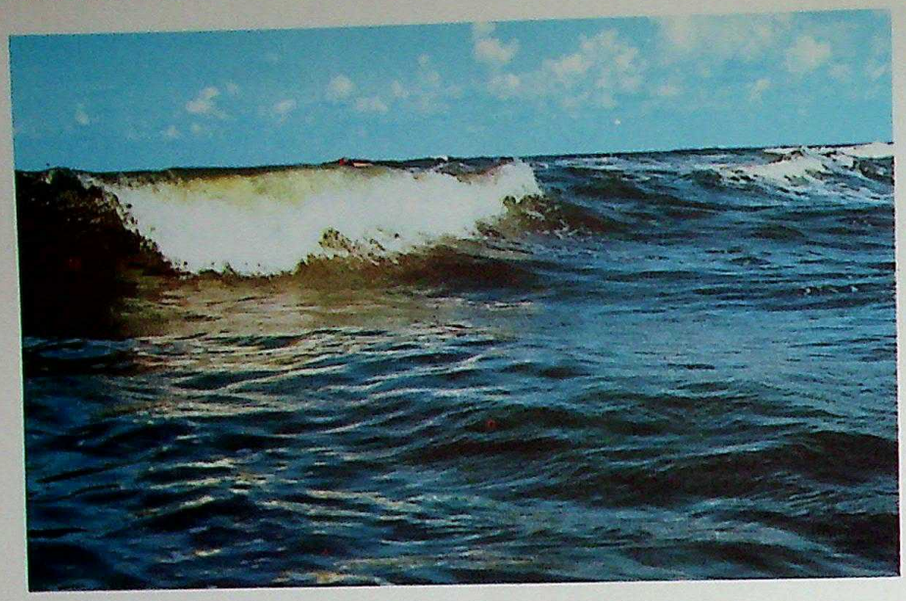


Driven by the wind, ocean waves pack considerable power. Devices have been designed to harness this power. They could provide one solution to the increasingly acute world energy shortage.

And they vary widely in their saltiness.

The major inland sea is the Mediterranean, which is bounded by Europe, the Middle East, and Africa. It is connected to the Atlantic by the Strait of Gibraltar. The Strait is only 13 km (8 miles) across at its narrowest point. The Mediterranean is somewhat saltier than the major oceans. This occurs because the climate is warm to hot, and much of the water in the sea evaporates. In the summer many of the rivers of fresh water feeding it become nearly dry.

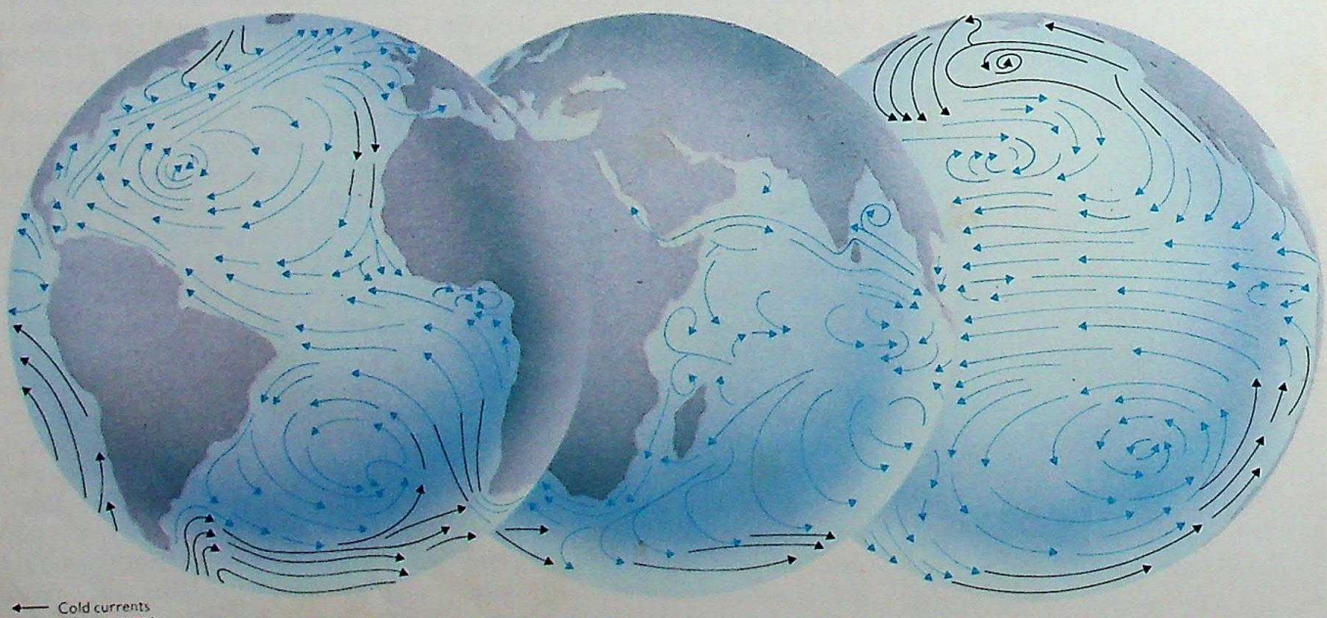
The Red Sea and Persian Gulf are also very salty for the same reasons. The Dead Sea between Israel and Jordan is very salty indeed. It contains seven times as much salt as the main oceans. It is so salty that you can float easily on its surface. It gets so salty because there is very little rainfall in the region, and the temperature is very high.

In contrast, the Black Sea and Caspian Sea to the north are much less salty than the oceans. They are amply fed by fresh water from the Russian Plains. And the temperature and the evaporation rate are lower. The Baltic Sea in northern Europe is also only slightly salty. Again, the climate is cool, and the sea is well watered by large rivers. However, with such a low content of salt, the Baltic freezes readily in the winter. This is unfortunate, because the Baltic is one of northern Europe's most important waterways.

Movements of the Oceans

The seas of the world are in constant motion. The most apparent movement is that of the *waves*, which pound the shore ceaselessly. Waves are caused mainly by the wind. It appears to the eye that the water travels with the waves, but it does not. Actually, the water merely moves up and down. Ordinarily, waves are not very high. But during a storm they have been known to reach up to 24 metres (80 feet). When such waves crash down, they can do terrible damage to coastal areas and shipping. Even ordinary waves can quickly wear away coastal rocks. They are a major cause of erosion.

Below: The general pattern of circulation of the surface currents of the world's oceans. In general the currents circulate in a clockwise direction in the northern hemisphere, and an anticlockwise direction in the southern hemisphere.
Right: A coral reef surrounds Mooréa, in the Society Islands. The lagoon behind is slowly being filled with sediment.



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Earthquakes and movements of the Earth's crust can set up devastating waves called *tsunamis*. Tsunamis have caused enormous loss of life over the years, especially in the Pacific region. In 1964 a tsunami 67 metres (220 feet) high was triggered off by an earthquake in Alaska.

The wind is also mainly responsible for the ocean *currents*. Over the world as a whole the winds tend to blow in certain directions. They are called *prevailing winds*. These winds tend to set the water in the oceans beneath them in motion. In the North Atlantic, for example, the main currents flow in a clockwise direction. They circle from the Equator, along the Gulf of Mexico and the east coast of North America, across the North Atlantic, and back past southern Europe and northern Africa. The warm current that flows past the Gulf of Mexico is known as the Gulf Stream. Part of this stream circulates past the British Isles and northern Europe towards the Arctic Ocean. It has a great influence on the climate of these regions, making them much warmer than they should be at such latitudes. Just as part of the Gulf stream branches off to the Arctic, a current of cold water sweeps down from the Arctic past Labrador. The Labrador current is the coldest in the North Atlantic.

General circulation in the South Atlantic Ocean is in an anti-clockwise direction. In general a similar pattern holds for the other major oceans. In the northern hemisphere the currents circulate clockwise, and in the southern hemisphere they circulate anti-clockwise. In the centre of these oceans are regions of relatively still water where seaweed often accumulates. The region in the North Atlantic is known as the Sargasso Sea. Freshwater eels from America and Europe swim there to spawn and die.

The third major movement of the sea is that of the *tides*. Along most shores, the tide comes in and goes out, or *ebbs* and *flows*, twice a day. Tides are caused mainly by the pull of the Moon. The Moon attracts the water of the oceans by its gravity as it moves around the Earth. When the Moon is above a point in the ocean, it tends to pull the water at that point away from the Earth. And there is a *high tide*. The Moon also pulls the Earth away from the water on the opposite side of the Earth. And another high tide is created there. In between the two high are *low tides*, where the water has been pulled away.

The highest tides occur when the Sun and Moon are lined up in the heavens. Their gravitational pulls are then combined. These tides are called *spring* tides. The lowest tides occur when the Sun and Moon form a right angle with the Earth. Then their pull is much weaker. These tides are called *neap* tides.

The amount the tide rises and falls varies from place to place over the Earth's surface. The greatest tidal range, of about 15 metres (50 feet), occurs in the Bay of Fundy, in eastern Canada. The tidal range in the Bristol Channel in Great Britain, is sometimes nearly 12 metres (40 feet). There is also a large tidal range at the mouth of the River Rance in Britanny. There, French engineers have built a special kind of hydroelectric power station which harnesses the power of the tides. Similar projects have been planned for the Bay of Fundy and the Bristol Channel.

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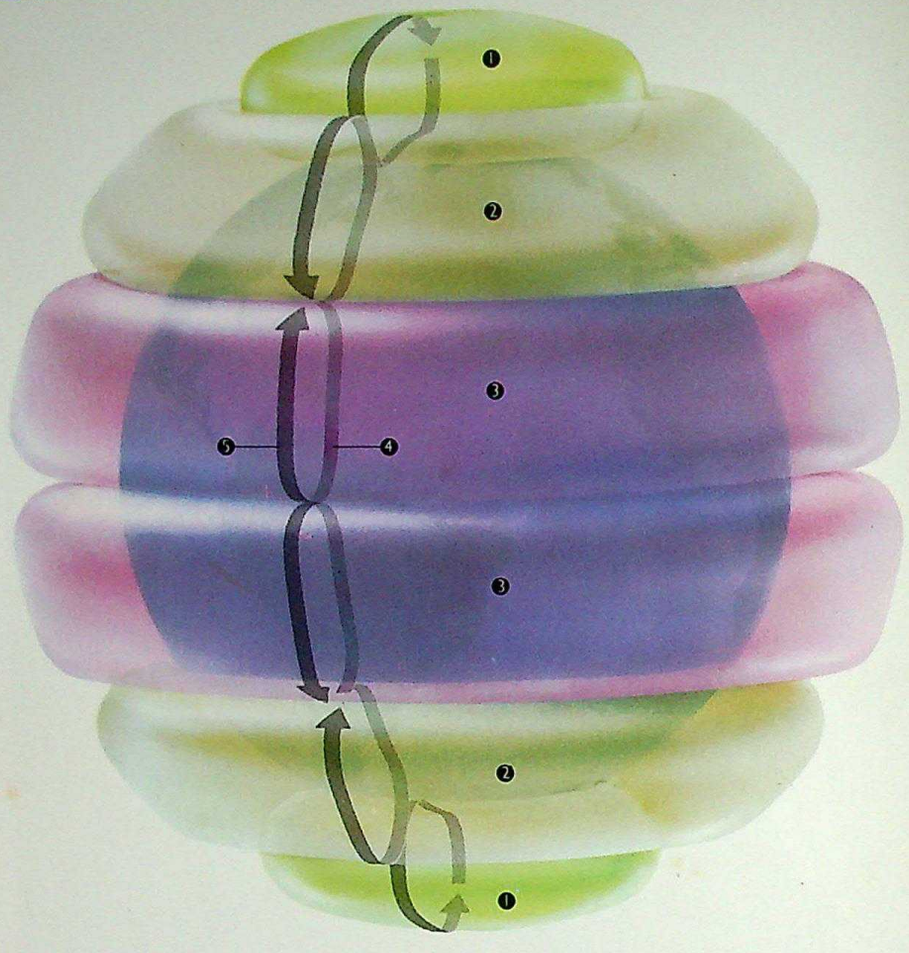
THE ATMOSPHERE

Life is made possible on the land and in the oceans because of the atmosphere. The atmosphere, or air, is a mixture of gases which covers the Earth like a blanket. And, like a blanket, it helps to keep the Earth warm. It traps the heat of the Sun, rather like a greenhouse does. It also acts as a shield to protect us from harmful rays from the Sun.

However, the most important thing the atmosphere does is to give us *oxygen* to breathe. Practically every living thing on the land, in the sea, and in the air must breathe oxygen to live. Oxygen is one of the two main gases in air; the other is *nitrogen*. Out of every five parts of air, nearly four parts are nitrogen and a little over one part is oxygen. The other main gas in the air is *argon*, but there is less than one part in 100 of argon. There are also traces of *carbon dioxide*. This gas is formed when we burn fuels such as coal and oil. Plants take in carbon dioxide from the atmosphere when they make food.

The air also contains water in the form of a vapour, or kind of gas. The amount of water vapour present varies from place to place and from time to time. It has a great influence on the weather and climate. Clouds form and rain falls when water vapour condenses, or forms droplets of water in the air. The droplets form around tiny specks of dust and smoke which are always present in the air. These specks are so small that they are invisible except under a microscope. A cupful of city air may contain more than 200 million specks of dust!



This diagram gives a simplified picture of the wind circulation in the atmosphere. Each 'belt' is called a cell. There are polar cells (1) near the poles; tropical cells (3) over the tropics, and mid-latitude cells (2) in between. The circulation is caused by hot air rising, then cooling and descending. It gives rise to low-level winds (4–5). In practice the atmospheric circulation is much more complicated. It is affected by the presence of land and water and by the Earth's rotation about its axis.

Layers of Atmosphere

We are not normally aware of it, but the air has weight and presses down on us. That is what we mean by *atmospheric pressure*. Every square centimetre of the Earth's surface at sea level supports a weight of about 1 kilogram of air. (Or every square inch supports about 15 pounds of air.) We have to say 'at sea level' because the weight or pressure of the air gets less and less as we go higher – the atmosphere gets thinner and thinner.

Most air is contained in the lowest 16 km (10 miles) of the Earth's atmosphere. Scientists call this region the *troposphere*. The temperature falls rapidly through the troposphere to about −55°C (−65°F). After the troposphere comes a region called the *stratosphere*. This extends upwards to about 50 km (30 miles). Pilots of jet airliners prefer to fly in the lower part of the stratosphere where they are 'above the weather'. One interesting feature of the stratosphere is a thick layer of *ozone*, a form of oxygen. The ozone layer is the part of the atmosphere which filters out dangerous rays from sunlight.

Further up still come layers called the *mesosphere* (up to 80 km, 50 miles) and the *ionosphere* (up to 480 km, 300 miles). In the ionosphere the gases are present as electrically charged atoms, or *ions*. The ionosphere is important for long-distance radio communications because it reflects radio waves back to Earth. Beyond the ionosphere there is scarcely any air present at all, and the atmosphere gradually merges into empty space. This region is sometimes called the *exosphere*.

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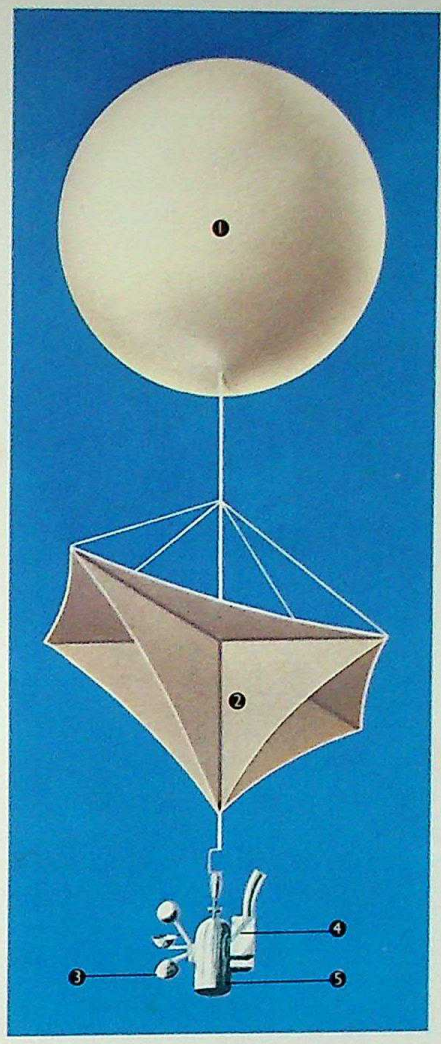
THE WEATHER

The condition of the air around us is constantly changing – from hour to hour, from day to day, and from month to month. It may be hot or cold, cloudy or sunny, wet or dry, calm or windy, clear or foggy. We call the general condition of the atmosphere at any time, the weather. At any point on the Earth the weather varies, often drastically, throughout the year. But year by year the general pattern of the weather remains much the same. The general weather pattern in a region, or 'average weather', is known as the *climate*. Widely different types of climate are found over the Earth. They have a profound effect on plant and animal life and also on the ways of life of the people (see page 30).

The weather plays such an important part in our lives that it is studied continuously and in great detail all over the world. Study of the weather is called *meteorology*. The people who study it are called *meteorologists*. They work at weather stations on land and on weather ships at sea. They take readings with instruments of such things as the temperature, pressure, and humidity (moisture content) of the air. They also measure the speed of the wind and the amount of rainfall. They study storms with radar.

To discover what conditions are like in the atmosphere, meteorologists launch balloons called *radiosondes*. These carry instruments and a radio to transmit readings back to Earth. The weather men also launch instruments into the atmosphere in sounding rockets. In recent years they have been greatly helped by weather satellites. These are placed into orbit high above the Earth. From there they can scan the whole surface of the Earth in a few hours. They send back to Earth temperature readings and cloud pictures. Some act as relay stations for collecting weather information from remote instruments on the ground. The American *Nimbus* and the Russian *Meteor* have been very successful weather satellites. The latest American satellites, called *SMS*, are able to scan a whole hemisphere in a few minutes.



The radiosonde is one of the most usual methods by which weather men are able to make meteorological observations in the atmosphere. It consists of (1) balloon, (2) radar reflector, (3) cup anemometer, (4) temperature recorder, (5) battery and barometric recorder.

With all this information, meteorologists can trace how weather is developing in different parts of the world. By drawing on past experience, they try to forecast what the weather will be like in the days and sometimes in the weeks ahead. Weather forecasts are very important in farming, and also in transport. Planes and ships can be warned of impending storms so that they can change course or take precautions. Motorists can be told when fog and ice are expected. In tropical regions early forecasting of the very destructive hurricanes and cyclones can save hundreds of lives.

Temperature

The most important aspect of the world's weather is the *temperature*. This is a measure of the amount of heat in the atmosphere. This heat comes from the Sun. The Sun gives out an enormous amount of energy as radiation (rays). Of the radiation that reaches the Earth, some is reflected back into space by the atmosphere, the clouds and the surface. But much gets absorbed by the atmosphere, which acts rather like a greenhouse. And the atmosphere is heated. The equatorial regions are heated most, and the polar regions least (see page 29). But air movements, or winds, help to distribute the heat more widely.

Temperature is measured by a *thermometer*. Common thermometers are thin tubes containing a liquid such as coloured alcohol or mercury. The column of liquid lengthens as the temperature rises and shortens as the temperature falls. The temperature is read against a standard scale. Today, temperatures are usually read on the Celsius, or centigrade scale (C). On this scale freezing water is zero degrees, or 0°; and boiling water is 100°. Sometimes the Fahrenheit scale is used. On this scale freezing water is 32° and boiling water, 212°. A comfortable room temperature for most people is about 20°C, or 68°F.

Moisture in the Air

The amount of moisture in the air also has a profound effect on the weather. Moisture gets into the air when the Sun heats the oceans and lakes. The water evaporates, or changes into vapour, which is absorbed into the atmosphere. As the water vapour rises through the air, it becomes colder. And it starts to condense,

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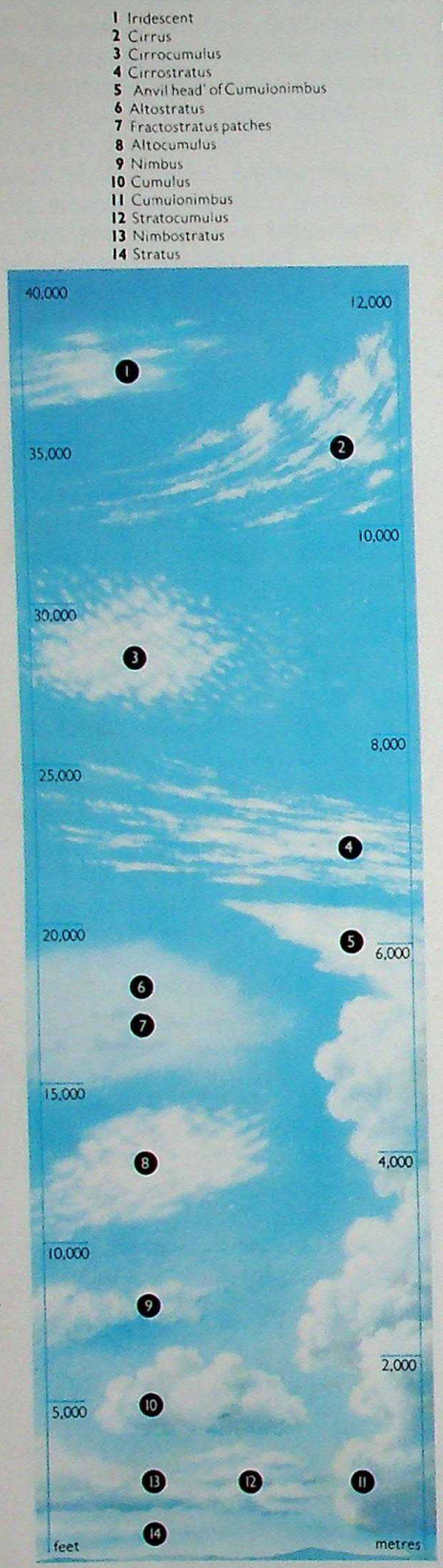


Various types of cloud form at different levels in the atmosphere, from a few metres altitude up to nearly 12 kilometres.

or change back into water again. It does so as tiny droplets. Sometimes the droplets become ice crystals. The droplets and ice crystals collect in masses as *clouds*.

The highest clouds are thin and feathery looking. They are called *cirrus*, or *mare's tails*. They are composed of ice crystals. Lower down, white fleecy clouds called *cumulus* form. They are the 'cotton-wool' clouds of summer. Some may develop into towering dark thunderclouds called *cumulo-nimbus*. In winter flat sheets of great *stratus* clouds are common.

In thunderclouds the water droplets and ice crystals are tossed about by air currents. And they become charged with electricity. Often this electricity builds up so much that it discharges. It travels inside the clouds and between the clouds and the Earth like a gigantic spark. This is what we call *lightning*. The air around the lightning flash gets suddenly heated and explodes with a bang. This we hear as *thunder*.

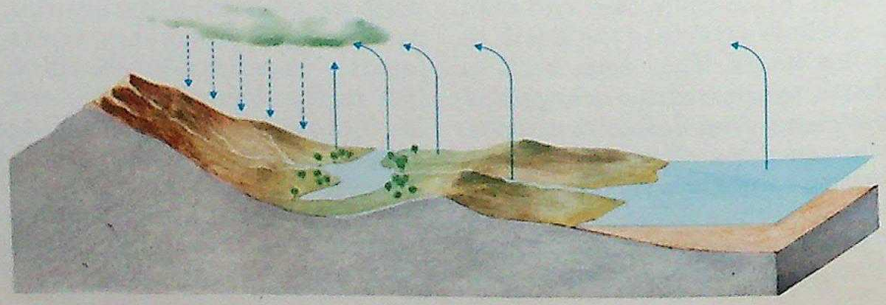
In many clouds the water droplets gradually get bigger and bigger. And they become so heavy that they fall to the ground as *rain*. Rain is one form of what is called *precipitation*. Snow, sleet, hail, fog, dew and frost are other forms of precipitation. *Snow* is made up of a mass of tiny ice crystals. *Sleet* is a mixture of snow and rain. *Hail* is frozen rain, which usually falls during thunderstorms. It is the result of water droplets being carried up into very cold air by air currents within the thundercloud.

Fog is really cloud which has formed near the ground. Mist is a lighter form of it. Fogs form when warm moist air meets a mass of colder air. Very bad fogs develop off Newfoundland, for example. There the warm waters of the Gulf Stream meet the icy waters of the Labrador current coming from the Arctic. Cold and warm, moist air meet, and dense fogs form. *Dew* is formed when water vapour in the air close to the ground condenses into water droplets. On very cold nights the vapour condenses as ice crystals, in the form of *frost*.

Meteorologists measure the amount of rainfall with a *rain-gauge*, which consists of a large funnel and a measuring cylinder. They measure the *humidity*, or amount of water vapour in the atmosphere, with an instrument called a hygrometer.

Air Pressure

The pressure of the air in the atmosphere varies from time to time. The way it changes provides a good indication of the future state of the weather. In general, decreasing pressure indicates that bad weather is on the way. Increasing pressure is generally an omen of good weather. The weather is greatly influenced by the presence of large low-pressure or high-pressure areas. Large low-pressure regions are called *depressions*, or *lows*. Large high-pressure regions are called *anti-cyclones*, or *highs*. Air generally moves from a high to a low. Highs usually bring good weather, while lows often bring clouds and storms.



There is a constant exchange of water between the Earth and the atmosphere. Water evaporates from the oceans and rivers, the soil, and from plants. The water vapour is cooled as it rises through the atmosphere. It condenses into droplets, and returns as rain.

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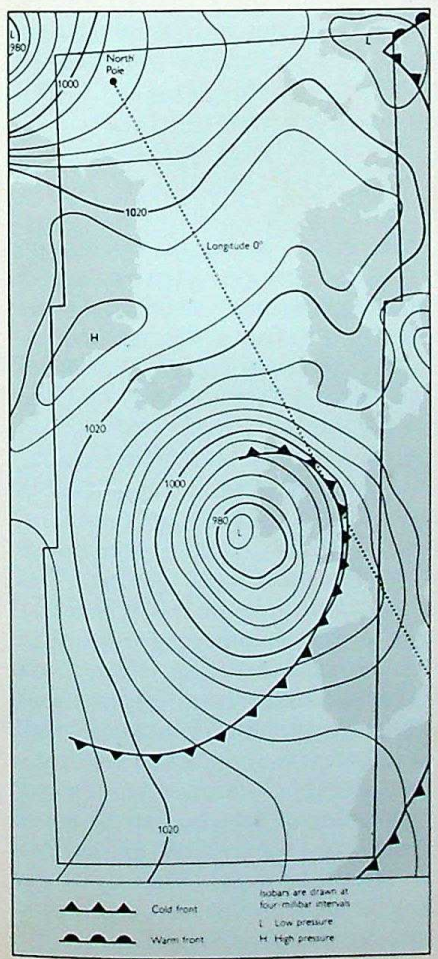
Air pressure is measured with a *barometer.* In a mercury barometer the length of a column of mercury changes as the pressure changes. The aneroid barometer contains an airtight box. The box contracts or expands as the pressure on it increases or decreases. Movement of the box moves a pointer over a scale. Most home barometers are of the aneroid type.

The Wind

Air will tend to flow from a region of high-pressure to one of low-pressure, just as water flows from high to low ground. We feel the movement of air as *wind.* Winds are important because they carry other elements of weather from

Right: A weather satellite picture of western Europe. It shows the typical spiral of a low, or depression, centred just west of Ireland. Below is the weather map of the same region at the same time. Note how the spiralling cloud marks the cold front.



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A spectacular display of forked lightning. Lightning marks the passage of a very high voltage electrical discharge from the clouds to the Earth.

place to place. Some winds spring up locally; others blow on a world-wide scale.

Meteorologists need to know the direction and speed of the wind. The direction of the wind is indicated by a *wind vane* or *weathercock*. Winds are always named after the direction *from* which they blow. A north wind blows from the north. Meteorologists measure wind speed with an *anemometer*. This instrument consists of several cups on a spindle. The cups whirl round when the wind blows. From the rate at which they spin, the wind speed can be calculated.

The strength, or force, of the wind is usually described in terms of the *Beaufort scale*. 0 on the scale is calm. Force 1 indicates light air movement – up to 5 kilometres an hour (km/h) or 3 miles per hour (mph). Force 6 indicates a strong *breeze* (up to 50km/h, 31 mph). Force 9 indicates a strong *gale* (up to 87 km/h, 54 mph). Force 12 is *hurricane* force (over 120 km/h, 75 mph). Hurricanes are destructive storms which occur in tropical ocean regions.

Local Winds

In seaside areas there is almost always a wind blowing. During the day the wind usually blows inland from the sea. At night the wind blows out to sea from the land. These *sea* and *land* breezes spring up because the land heats up and cools more rapidly than the sea. In the day the land becomes hotter than the sea. The air above it becomes hot and rises. Cooler air from over the sea moves in to take its place. At night the situation is reversed. The land cools quickly and becomes colder than the ocean. The warmer air above the ocean rises, and cool air from over the land moves in to take its place.

Sometimes sea and land breezes occur on a continental scale and produce the winds known as *monsoons*. The word 'monsoon' means 'season'. The direction of the wind varies, not from day to night, but from season to season. The monsoon blows from sea to land during the summer, when the land is hotter than the sea. It blows from land to sea in the winter, when the sea is hotter than the land.

Monsoons occur in warm and tropical regions of the world including eastern Africa, India, south-east Asia, Indo-China, Japan and northern Australia. The summer monsoon blows from across the equatorial oceans and picks up a great deal of moisture. On reaching land, it deposits this moisture in the form of torrential rain. The winter monsoon blows from the land and is dry. The winter monsoon in India is fairly gentle and is not very cold. The winter monsoon blowing from Central Asia over China and Japan is strong and bitterly cold. The India monsoon is separate from the monsoon system for the remainder of south-east Asia because of the lofty Himalaya mountain system. This forms a barrier to weather between India and the rest of Asia.

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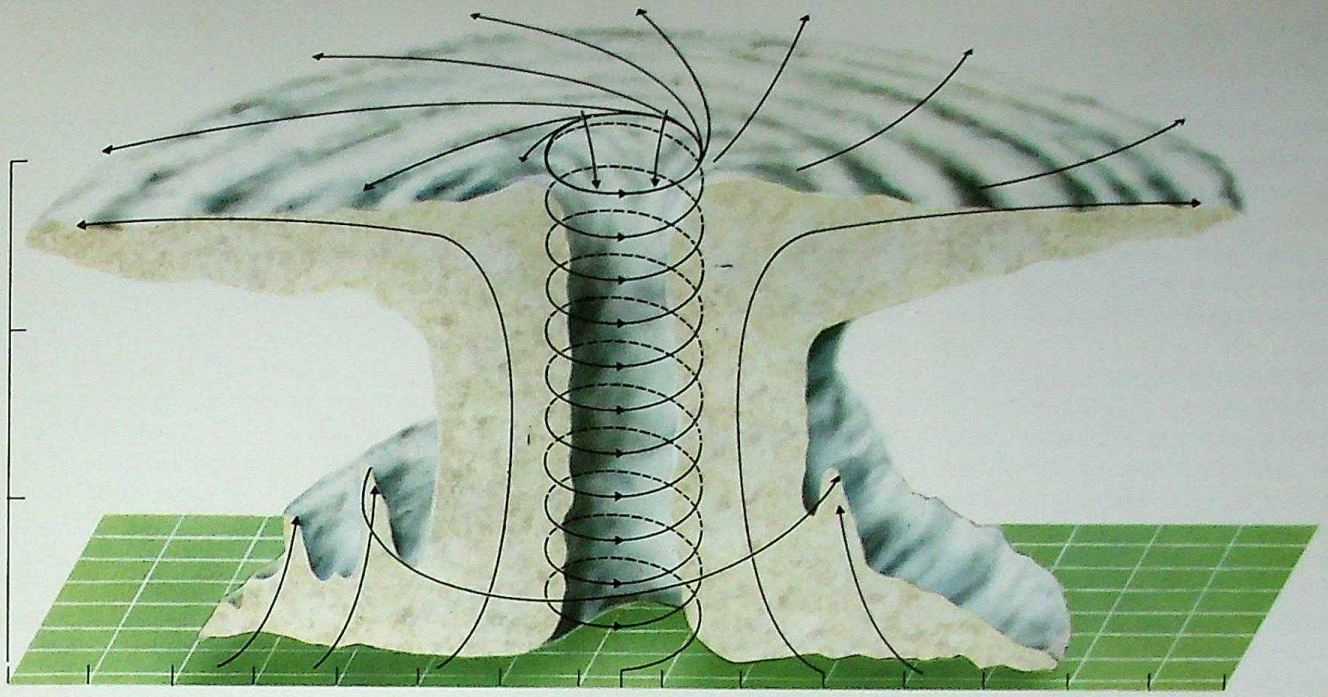
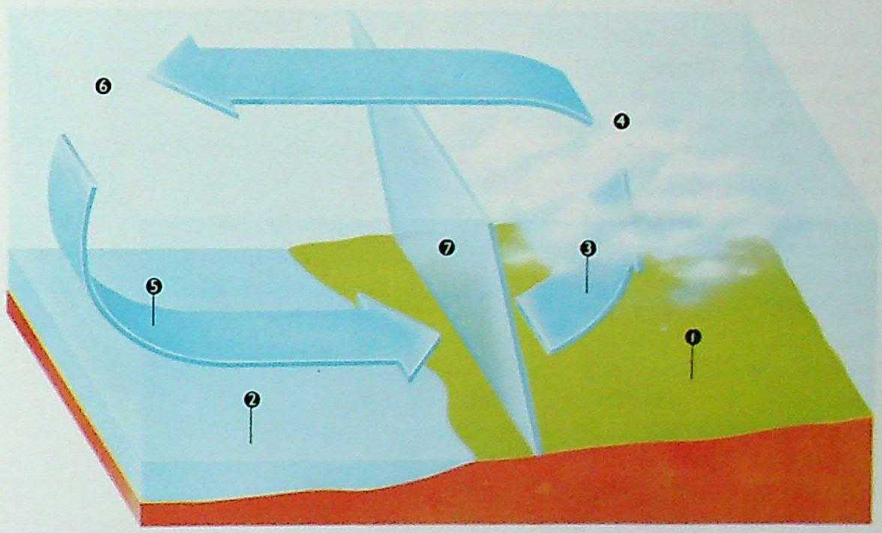


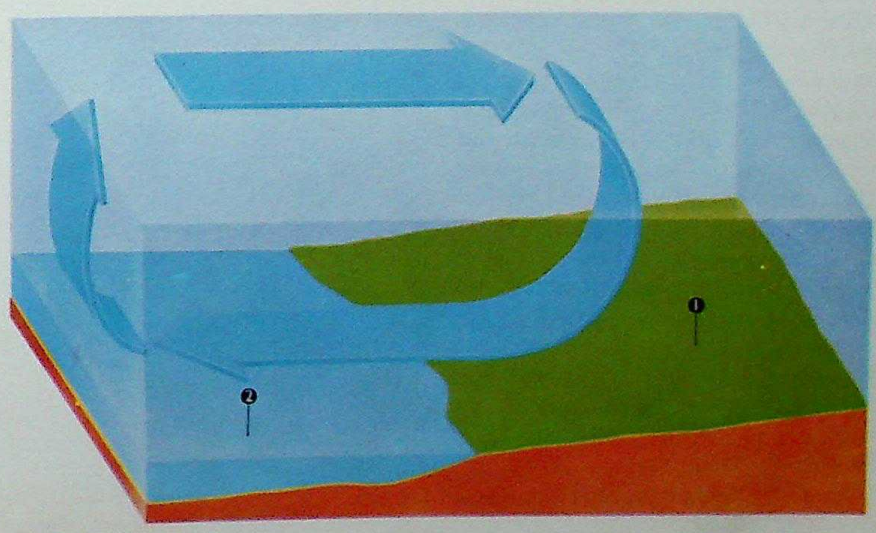
Above: A cross-section through a hurricane. The wind spirals around the centre, or eye, of the hurricane at phenomenal speeds – often up to 250 kilometres an hour. The odd thing about a hurricane is that in the eye it is dead calm. Note how large the hurricane is.

Right: How the coast affects local wind patterns. The top diagram (A) shows the situation during the day. The land (1) tends to get warmer than the sea (2). The warm air rises (3), creating an area of high pressure (4). The air over the sea cools and sinks (5), resulting in an area of low pressure (6). Eventually the pressure differences cause the air to circulate, with a breeze blowing from sea to land. The plane (7) shows the sea-breeze front. At night (B) the situation is reversed. The land (1) becomes cooler than the sea (2), and a breeze develops, blowing from the land out to sea.



Daytime: Sea breeze

Night-time: Land breeze



Most high mountains, like the Himalayas, act as barriers to winds on either side. Some, however, do not. Warm winds from the south blow over the Alps. As they rise, they lose their moisture as rain or snow. The now dry wind then descends the north side of the Alps. As it descends, it is compressed. It becomes warm, like air in a pump becomes warm

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when you compress it. This warm, dry Alpine wind is called the *Föhn*. *Föhns* are common in Swiss valleys north of the Alps. In spring they make the snow disappear quickly from the pastures. A similar wind to the *Föhn* blows over the Rocky Mountains in the United States and Canada. It is called the *chinook* (meaning snow-eater).

Other well-known local winds are the mistral and the sirocco. The *mistral* is an icy cold strong wind that blows down from the Alps towards the *Mediterranean*. It can wreak havoc with fruit crops. The *sirocco* is a hot, dusty wind that has its origins over the Sahara Desert. It often reaches Sicily and Italy as a stinging, throat-parching wind. But sometimes it is laden with moisture and brings rain.

Cyclones and Tornadoes

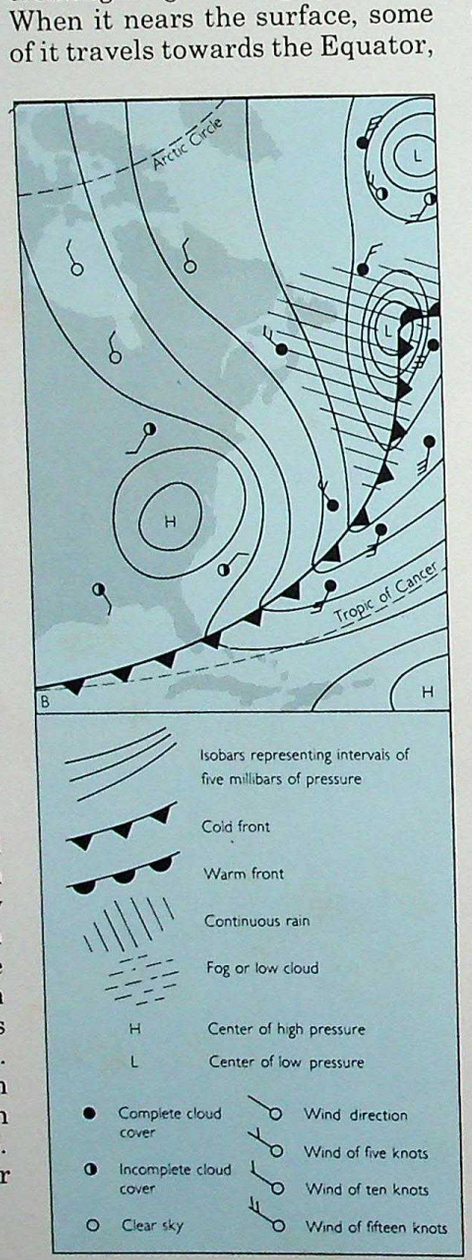
In tropical regions, intense storm areas called *cyclones* occur, in which the winds may reach as much as 240 km/h (150 mph). They can cause tremendous damage. Cyclones are caused by the rapid uprush of warm air above tropical seas. This creates a depression, or region of very low pressure. In this region strong winds spiral inwards around a centre which is calm. In the Northern Hemisphere, they spiral in an anticlockwise direction. In the Southern, they spiral clockwise. In the Caribbean region cyclones are known as *hurricanes*. In the Pacific they are called *typhoons*.

Tornadoes are a kind of small cyclone, or whirlwind. They form inland in intensely hot, thundery weather. They often develop in the interior of Australia and the United States. They sweep a path at most only a few hundred metres wide and a few kilometres long. But they destroy everything in their path, with wind speeds often approaching 500 km/h (300 mph). At sea a tornado sucks up water and is called a *waterspout*.

Worldwide Winds

Winds blow on a global scale as well. The region around the Equator is the hottest on Earth. The air there becomes hot and rises; the air pressure is low. Cooler air from cooler regions to the north and south of the Equator moves in to replace the rising air. A circulation pattern develops with the hot air rising from the Equator and moving towards the Poles. At the same time cold air from the direction of the Poles moves over the surface towards the Equator.

As the hot air from above the Equator moves Polewards, it cools. And as it cools it becomes heavier. At a latitude of about 30 degrees, it sinks back to Earth, creating a region of high pressure. When it nears the surface, some of it travels towards the Equator, while some travels towards the Poles. This gives rise to the two major wind belts in each hemisphere. The winds do not blow directly north or south, though. They are deflected to the east or west because of the Earth's rotation.



Some of the symbols used by meteorologists on their detailed weather maps, which they call synoptic charts.

In the Northern Hemisphere the winds blow from the north-east towards the Equator, and in the Southern from the south-east. They are known as *trade winds*. The winds blowing towards the Poles blow from the south-west in the Northern Hemisphere, and from the north-west in the Southern. They are known as *prevailing westerlies*. In the Southern Hemisphere there is so little land that the westerlies blow strongly. Latitudes between 30 and 40 degrees South are called the *roaring forties* for this reason.

In contrast to the strong trade winds and prevailing westerlies, the winds in the equatorial region are very light or absent. The air is moving upwards, and this often causes sudden thunderstorms to arise. This region is called the *doldrums*. In the doldrums, sailing ships used to be becalmed for days on end. This explains the expression 'in the doldrums', meaning 'in low spirits'.

Air Masses and Fronts

Weathermen often talk of *air masses* when describing the circulation of air in the atmosphere. These are bodies of air with similar properties. It is the interaction of different air masses that determines our weather.

Changes in the weather occur when an air mass at one temperature meets that at another temperature. The point at which they meet is called a *front*. A *warm front* occurs when a warm air mass pushes a cold air mass before it. Being warmer, though, the air rises over the cold air mass along the front. Clouds form and rain falls. A *cold front* occurs when a wedge of cold air thrusts under a warm air mass. Again, the warm air is forced to rise, and showers often result. Sometimes a cold front overtakes a warm front to form an *occluded front*. This is marked by continuous rain.

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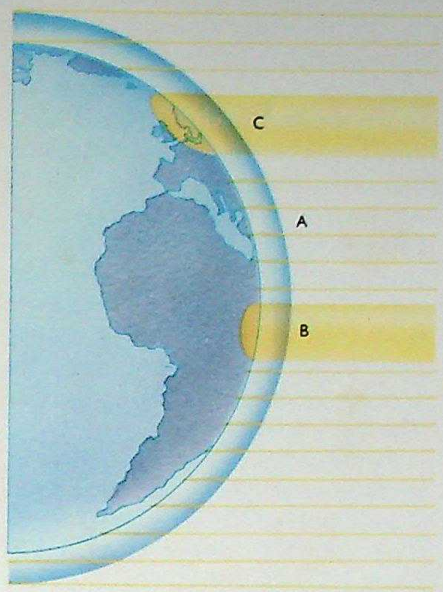
THE CHANGING SEASONS

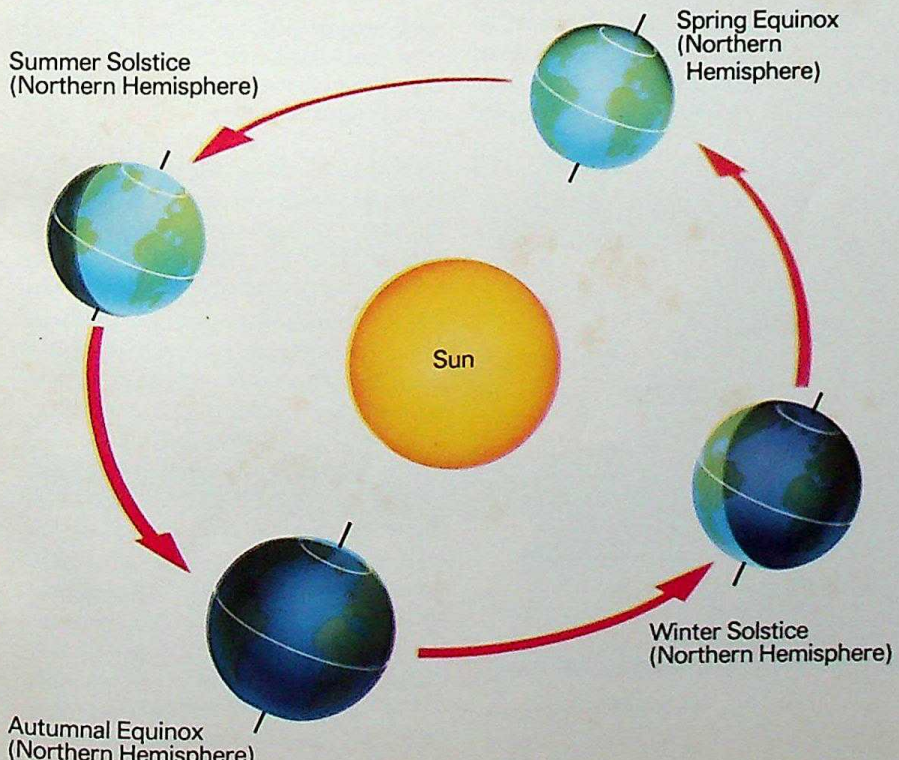
The type of weather people experience depends on where they are on Earth. The weather an Eskimo is used to is totally different from that an Arab would expect. The type of weather experienced also depends on what time of the year it is. A New Yorker would expect freezing ice and snow in January but hot sunshine in July.

The main thing that affects the weather at any place is the amount of heat received from the Sun. This amount varies from place to place over the Earth's surface because the Earth's surface is curved. It varies through the year because the axis on which the Earth spins is tilted in space. The temperature variations throughout the year give rise to what we call the *seasons*.

It is quite easy to see how the amount of sunlight received varies from place to place, or rather from latitude to latitude. Look at the diagram, right. Near the Equator the Sun's rays spread over and heat the smallest area. Away from the Equator the sunlight is spread over a larger area and cannot heat it up so much. The temperature there is therefore lower than near the Equator. Near the poles, the sunlight strikes the surface at the least angle and is spread over the largest area. Temperatures are therefore lowest near the poles.



Above: Equal-size beams of sunlight (A) striking the Earth in different places. Near the Equator (B) the Sun's rays are directly overhead and heat up the smallest area. Elsewhere (C) the sunlight strikes the surface at an angle. It is spread over a larger area and gives less heat.
Below: How the tilt of the Earth's axis brings about the seasons. The solstices mark the beginning of summer and winter.



However, the angle at which the Sun's rays strike the Earth changes throughout the year. This is because the Earth's axis is tilted, and it always points in the same direction in space. This means that as the Earth travels around the Sun during the year, the axis points more towards the Sun at some times than it does at others. The diagram at the bottom explains this.

Twice a year the axis is most tilted relative to the Sun. On about June 21 the Northern Hemisphere is angled most towards the Sun. The sunlight strikes the surface at the greatest angle and heats it most. It is the longest day, and we say *summer* has begun. Six months later, on about December 22, the Northern Hemisphere is angled most away from the Sun. The sunlight strikes the surface at the least angle, and heats it least. It is the shortest day, and we say *winter* has begun.

Midway between June and December and December and June are times when the Earth's axis is angled neither towards nor away from the Sun. At these times the Sun is directly above the Equator at noon. Day and night are of equal length throughout the world. These times are called the *equinoxes* (meaning 'equal nights'). They occur on about March 22 (spring equinox) and about September 23 (autumnal equinox). They mark the beginning of *spring* and of *autumn* respectively.

Things are the other way round in the Southern Hemisphere. This is angled most away from the Sun while the Northern Hemisphere is angled most towards the Sun. So it is winter in the South when it is summer in the North. Likewise it is summer in the South when it is winter in the North, and spring in the South when it is autumn in the North.

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CLIMATE & VEGETATION

The weather in a region changes from day to day and from season to season. But the overall pattern of weather over the years remains much the same. For example, the average temperature of a region varies little year by year. So do the amounts of annual rainfall and the annual number of sunny and cloudy days. We call the average weather the *climate*.

The climate varies widely across the Earth. Most of northern Africa is a vast desert region where little or no rain falls at any time of the year. It has little plant life. This is in marked contrast to equatorial Africa, farther south. There, heavy rain falls throughout the year, and a rich variety of plant life flourishes. Whereas rainfall in the Sahara desert may only be a few millimetres a year, that in equatorial regions may approach 4000 millimetres (250 inches) a year.

At the Equator the climate is very hot, in contrast to that at the Poles, which is very cold. At the Equator temperatures regularly exceed 40°C (over 100°F) throughout the year. But near the Poles, the temperature can plunge to 40°C below freezing (−40°F) in winter on the coast, and as low as 88°C below freezing (−127°F) inland.

Rainfall and temperature are two of the most important things that determine climate. The Earth is usually divided into a number of climatic regions according to their average rainfall and temperature. Rainfall and temperature also determine what kind of vegetation is found in a region. Observing the natural vegetation gives us a much closer picture of the climate of a place than the local weather conditions we may experience at one time. In fact vegetation is often called 'the mirror of climate'.

As plant life varies with climate, so does animal life. Each animal is adapted for life in the climate it lives in. The polar bear has a thick coat of fur to protect it from the Arctic cold; the whale has a thick layer of fat (blubber) under its skin to protect it from icy water. The elephant on the other hand has a hairless skin with no layer of fat beneath it. It needs no protection from the cold because it lives in a hot tropical climate.

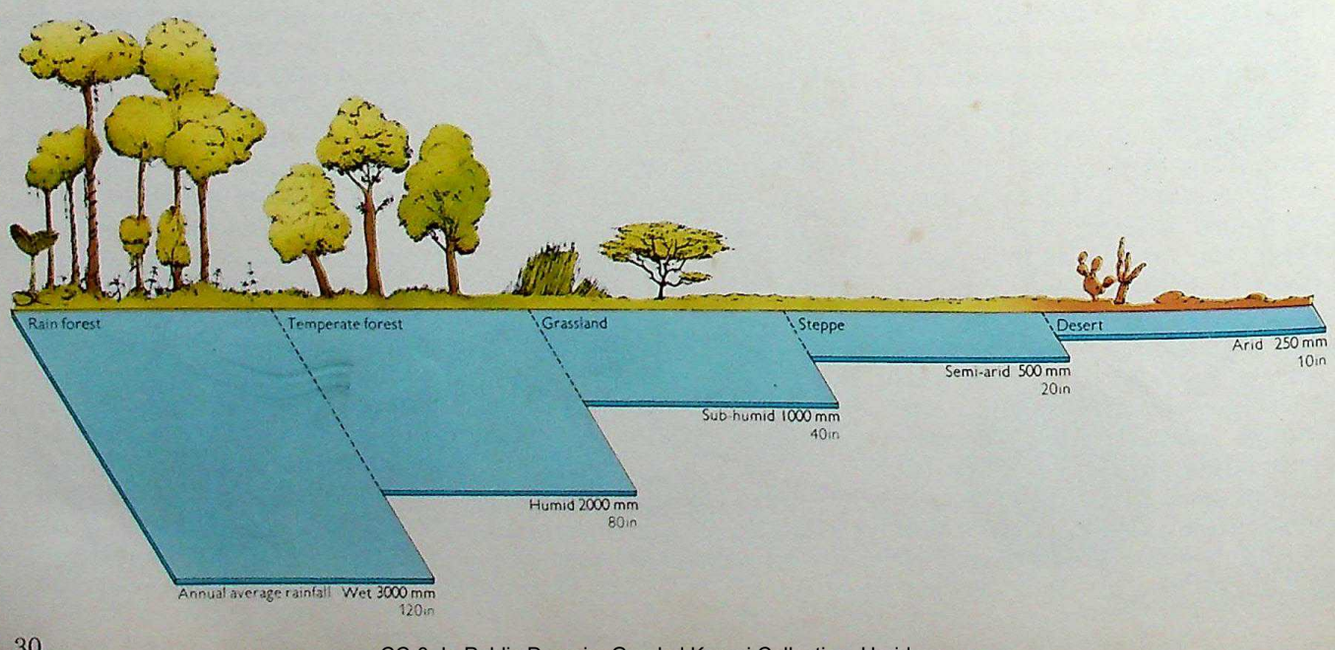
The climate profoundly affects Man's activities, too. It influences the kind of clothing he wears and the kind of house he lives in. In the tropics he need wear little or no clothing, and he needs only light shelter. In colder lands he needs warm, heavier clothing and heated, well-insulated houses to live in. Climate affects the kind of crops Man grows and the livestock he raises. For example, wheat grows best in a relatively cool climate. Rice, though, needs a hot, rainy climate to thrive.

The climate often affects the transport Man uses. In the Amazon rain forests transport overland is difficult because the plants grow so quickly that tracks and roads quickly become overgrown. So the main means of transport is by water. In polar regions sledges, skis, and tracked vehicles are needed to travel across the frozen snowy wastes.

Factors Affecting Climate

In general the temperature of a region is largely determined by its latitude, or its distance from the Equator. As we have seen, the warming effect of sunlight becomes less as we go farther from the Equator (see page 29). If latitude were the only factor affecting climate, then the climatic regions would ring the globe in parallel bands. They do not, however, because many other things affect climate. Climate is influenced by altitude, or the height above sea level; by the presence of the sea; by mountains and other surface features; by the winds, and by ocean currents.

The type of vegetation that grows on the land depends to a great extent on the amount of annual rainfall, as the diagram shows.



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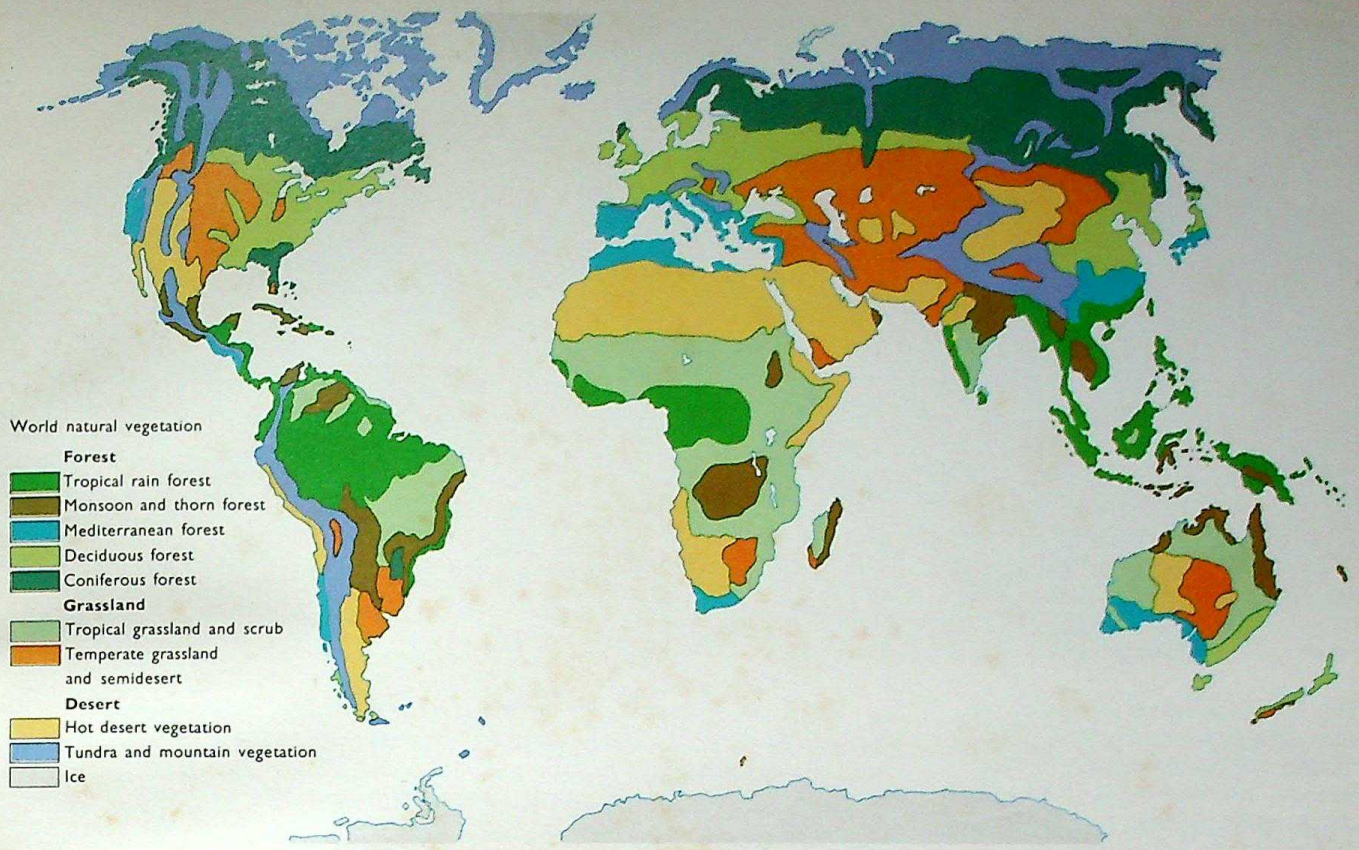
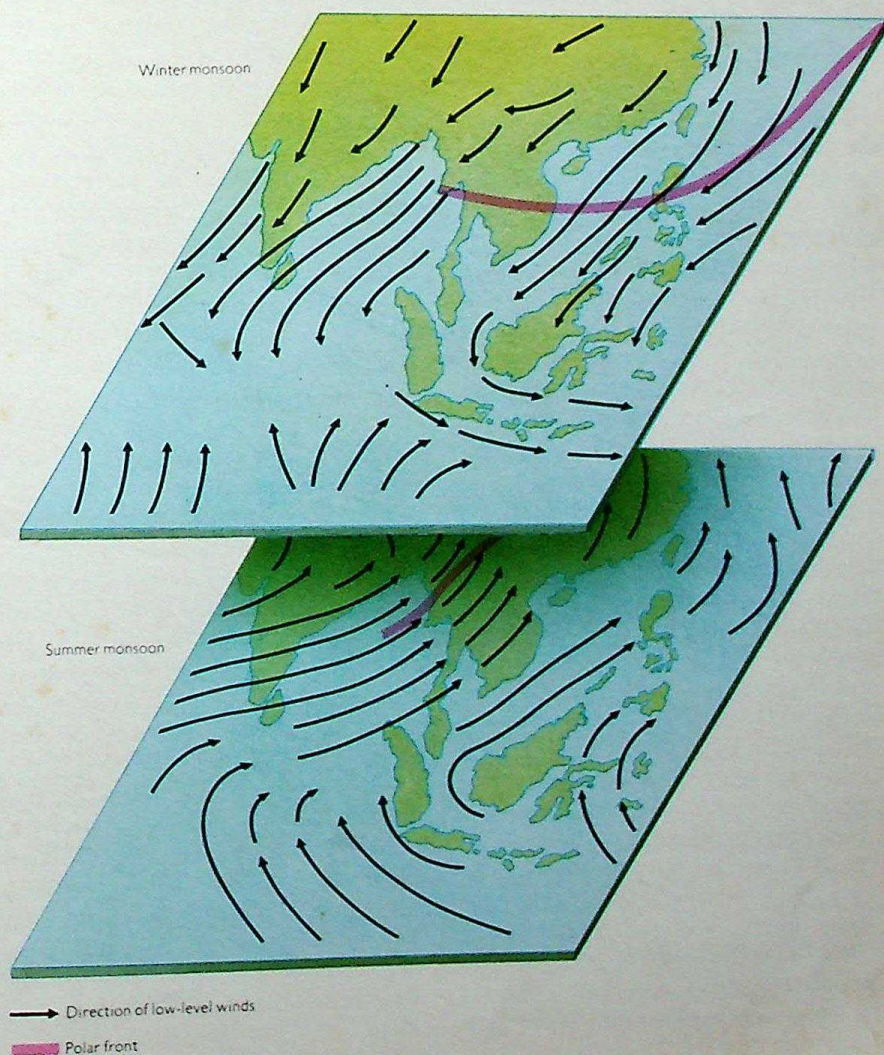


Above: A natural vegetation map of the world. It can also be interpreted as a climatic map, since vegetation is closely related to the climate.
Right: An illustration of the seasonal monsoon winds of South-east Asia. In winter (top) they blow, cold and dry, out to sea. In summer (bottom) they sweep inland, hot and moist, from over the tropical oceans, bringing torrential rain.



The altitude affects climate because the air becomes thinner and colder the higher you go above sea level. In Africa the plateaux on the Equator have a pleasant climate because they are 1000 metres or more above sea level. Nearby lowland regions, however, are often unbearably hot and humid. Africa's second highest mountain, Mount Kenya, lies close to the Equator. As you climb it, you pass in turn through different climatic zones as the temperature falls with increasing height. At the foot of Mount Kenya the climate is tropical, while at the summit (5,199 metres, 17,058 feet) it is polar and there are permanent glaciers.

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The relatively warm waters of the Gulf Stream system (yellow) greatly modify the climate of north-west Europe. Without the Gulf Stream, the Scottish Highlands (right) would in summer be as icebound as Labrador (left), at the same latitude across the Atlantic.

The sea has a steadying effect on the climate because it heats up and cools more slowly than land does. Places on the coast therefore tend to be cooler in summer and warmer in the winter than those inland. This effect is especially noticeable at a continental level. The interior of North America, Asia, and Europe experience a much more extreme climate – hotter summers and colder winters – than the coastal regions.

Mountain ranges can have a marked effect on climate. The Himalayas, for example, protect India from cold northerly continental winds. The Alps shield the French Riviera from the frigid wind called the mistral. These ranges lie roughly east-west. The interior of North America lies open to the Arctic air streams, however, because there is no east-west range for protection.

The temperature differences over the Earth give rise to massive movements of the air or winds. Wandering air masses play a vital part in shaping the climate. Icy air from northern regions brings bitterly cold weather when it sweeps southwards through the northern United States and Russia, for example. Over hot desert regions like the Sahara, masses of dry, hot air form. They leave scorching heat waves and drought in their wake. Masses of warm air pick up moisture after passing over the ocean. As they sweep inland, they bring rain, which is torrential in the tropics. In many tropical regions this air movement is seasonal. Winds blow inland during the summer and out to sea in the winter. In the winter, the winds are cold and dry. Such seasonal winds are called *monsoons*.

The climate of coastal regions is greatly affected by ocean currents. These currents vary in temperature, and they bring with them masses of air of different temperature and moisture content. They can warm or cool coastal climates. The warm Gulf Stream Drift brings exceptional warmth to north-western Europe. At similar latitudes across the Atlantic, however, the climate is exceptionally cold. This is because of the icy Labrador current coming from the Arctic. The eastern coast of South America is very warm because of the warm Brazilian current coming from the tropics. The other side of the continent, however, is chilled by the cold Peruvian current.

Tropical Rainy Regions

In the tropical regions of the world, we can recognize several different types of climate. Each is distinguished by a different pattern of annual rainfall. The *tropics* are the region around the Equator bounded by latitude $23\frac{1}{2}^\circ$ North and latitude $23\frac{1}{2}^\circ$ South. The $23\frac{1}{2}^\circ$N parallel of latitude is known as the *Tropic of Cancer*. It represents the most northerly point at which the Sun is ever directly overhead at noon. The $23\frac{1}{2}^\circ$S parallel is known as the *Tropic of Capricorn*. It represents the most southerly point at which the Sun is ever directly overhead at noon.

Close to the Equator the climate is described as *equatorial*. Except in a few highland areas, the weather is always hot and humid. Heavy rain falls most days in the afternoon. There is virtually no seasonal change. The vegetation in the equatorial region is *luxuriant* – it grows abundantly and vigorously. It makes up what is called tropical rain forest. The largest rain-forest region is the so-called *selvas*, in the Amazon basin in South America. The trees are tall and their foliage shuts out the light, keeping the forest floor dark. Exotic birds and insects abound, as do snakes. Monkeys are common, and apes are found in some parts.

Surrounding the equatorial forest region in Africa is a broad

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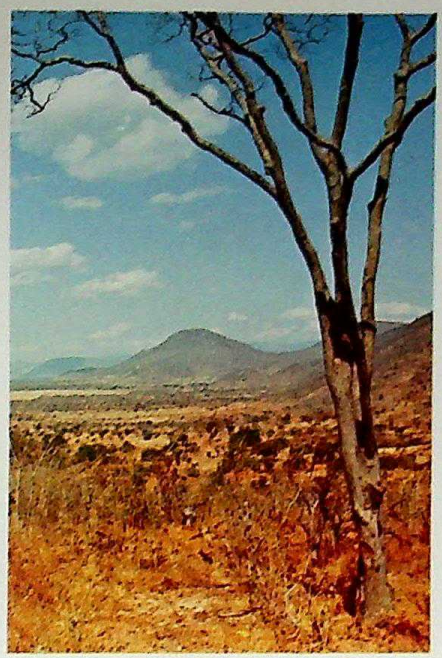
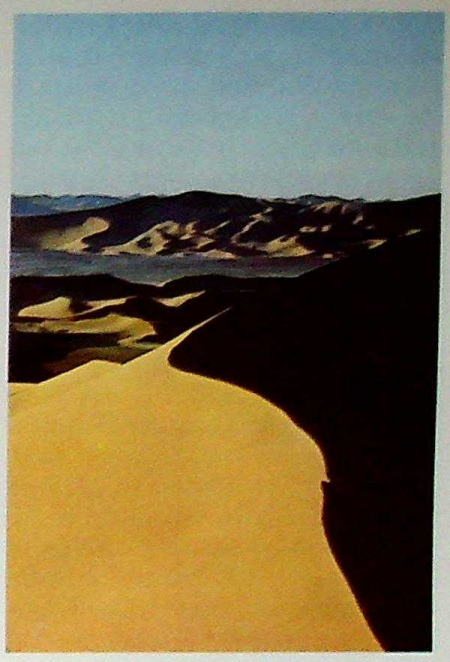
climatic zone which has two distinct seasons, a wet and a dry. In the Sudan, for example, heavy rain falls in summer, between June and September. There is little rain during the rest of the year. Similar regions occur in South America and Australia.

The typical vegetation of this climate is *savanna*. It consists of tall coarse grasses, with scattered trees and shrubs. Some grasses, such as elephant grass, may reach 5 metres (over 15 feet) high. Trees include the wide-trunked baobab, or bottle tree, and the thorny acacia. The African savanna is 'big-game' country, with abundant animal life. Lions, elephants, rhinoceroses, antelopes, zebras, giraffes and hyenas are common.



Savanna country near Iringa, in central Tanzania, with parched grass and scattered trees.



The shifting sand dunes of the Sahara Desert constantly change their shape with wind direction.

Luxuriant vegetation like this grows in the very hot and humid Zaire (Congo) basin.

Some areas are under cultivation.

Another tropical rainy climate is the monsoon climate of India, south-east Asia and northern Australia. This is also a two-season climate. The summer rains are brought by monsoon winds blowing inland from the sea. In the winter the winds change direction and blow out to sea, and the climate is dry.

Dry Regions

The largest regions with a dry climate are the hot deserts. Hot deserts are found in the Americas, Africa, Asia and Australia on either side of the Tropics of Cancer and Capricorn. The greatest desert region borders the Tropic of Cancer in northern Africa and south-west Asia. It includes the Sahara, and the Libyan, Arabian and Thar deserts. There is also an arid desert region near the Tropic in the south-western United States. In the Southern Hemisphere the largest desert region is in western Australia. Other southern deserts include the Kalihari in south-west Africa and the Peruvian and Atacama (Chile) deserts in western South America.

Notice that the deserts are all on the west of the continents. This is a consequence of the trade winds, which are blowing constantly offshore. By the time they reach the western land margins, they have dropped any moisture they may have had. They are hot and dry. In general, desert regions are classed as those with under 250 mm (10 inches) rain a year. In some deserts rain does not fall for years at a time. Chile's Atacama Desert is the driest place on Earth. Virtually no rain has fallen there for four centuries.

Arid desert areas have higher temperatures even than equatorial regions. In equatorial regions the skies are often cloudy and rain falls. This prevents the temperature rising too high. In the cloudless deserts, however, the Sun beats down relentlessly, and can heat the sand to more than 80°C (nearly 180°F). The highest air temperature ever recorded was 58°C (136°F) in the Libyan Desert in 1922. Because desert skies are cloudless, the land loses heat rapidly at night. In winter the temperature may even drop to below freezing.

The desert landscape is in general a desolate one. Many deserts are vast tracts of shifting sand, which may pile up into dunes 100 metres (about 300 feet) or more high. Others are regions of bare

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rock and baked clay. When there is some rainfall, scattered thorny scrub and tough, wiry grasses may grow. In America, cacti are found, which are specially adapted to survive drought. In some parts of the desert, however, ground water comes to the surface. Then an *oasis* grows up, where plants such as date palms thrive. If the oasis is large, crops such as cotton and sugar cane may be grown.

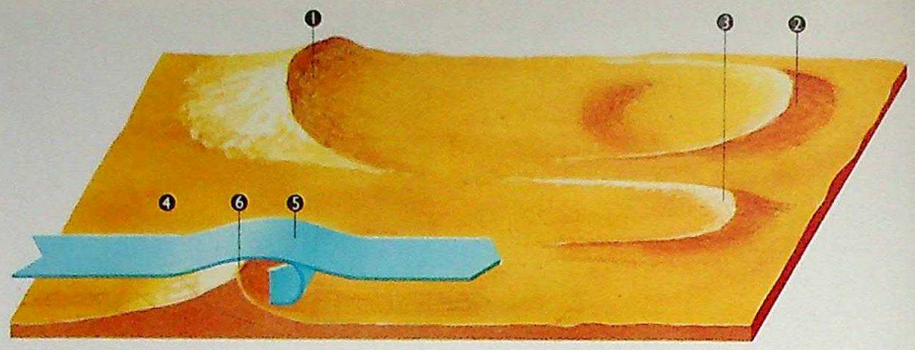
Arid regions are to be found in other parts of the world as well. The western plateaux of the United States have scant rainfall. So do the highlands of Mongolia in Central Asia, which include the vast Gobi Desert. In South America another notable arid region lies in Patagonia. Such regions are dry because they are shut off from most sea winds. They are often called *temperate deserts*. They usually experience extremes of temperature. The temperatures in summer are high, though not as high as in hot deserts nearer the Equator. The winter temperatures are, by contrast, very low.

Steppe-Lands

Other relatively dry, but not desert regions include the *steppe-lands* of central Europe and Asia. Here the summers are hot, and the winters are very cold. The great *prairies* have a similar climate.

The natural vegetation of the steppes and prairies is grassland, and there are few trees. This provides excellent grazing for cattle and sheep. On the prairies cattle ranching is practised on a large scale. On the steppes, there are still many nomadic (wandering) herdsmen. Vast areas of prairies and steppes have been planted with wheat. They are the biggest wheat-producing regions in the world.

Similar lands are found in the Southern Hemisphere. In South America is the *pampas* of Argentina, famous for its beef-cattle ranches. In south-east Australia are the Murray-Darling plains, one of the country's most productive farming regions. In South Africa is the high *veld* (grassland).



Sand dunes can have various shapes, some of which are shown here. They include the barchan, or crescentic (1), parabolic (2) and hairpin (3). When a crescentic dune (4) experiences a steady wind current (5), the dune ridge (6) moves forwards, rather like a wave.

This is a fertile plateau of rich farmland in the Transvaal and Orange Free State. The southern steppe-lands are warmer than those in the north and do not experience such a drastic change from summer to winter.

Mid-Latitude Regions

These are regions of cool to warm temperatures and reasonable rainfall. They are often termed *temperate* regions. Their climate varies according to their geographical location.

The lands around the Mediterranean have a hot summer, when very little rain falls. Most rain falls during the winter, which is warm. Mediterranean-type climates are also found on the other continents, in California, central Chile, Cape Province, and south-west and southern Australia. All these regions are in the western margins (edges) of the land masses. They are influenced by wet westerly winds in the winter, and the dry trade winds in summer.

The climate suits the cultivation of vines, olives, figs and citrus fruits. Natural vegetation includes evergreen trees and cork oaks, and dense, thorny scrub. This scrub is called *maquis* in France, *macchia* in Italy, and *chaparral* in California. All the vegetation is adapted to withstand the long summer drought. In the wetter areas large trees such as the sequoia (California) and cedar (Lebanon) flourish.

On the eastern margins of the continents in middle latitudes are regions with hot summers and warm to cool winters. Typical regions are the south-eastern United States, eastern Asia, southern Brazil and Uruguay, south-east Africa and eastern Australia. In the eastern Asian region heavy rain falls mainly in the summer with the monsoon winds. Elsewhere the rain falls in summer and winter. In general winters are cooler than they are on the west of the continents, and the rainfall is heavier.

The natural vegetation includes forests of hardwoods such as walnut (in the United States); parana pine (South America); palm (South Africa), and eucalyptus (Australia). Cultivated crops include cotton, tobacco, maize, rice, tea and coffee.

Western Europe has cool winters and warm summers. Rain falls in all seasons. It is brought mainly by the prevailing westerly winds blowing in from the Atlantic. Regions with a similar climate are found in British Columbia, on the West Coast of Canada, southern Chile and New Zealand. The natural vegetation is deciduous forest. Forests of oak, elm, beech, birch and poplar once covered the regions. Now most of them have been felled to make way for settlement and cultivation. Evergreen conifer trees also grow in the cooler parts. Farming and market gardening are major occupations. Crops include wheat and other cereals, potatoes and sugar beet. Dairy farming is important, too.

Eastern Canada and north-eastern North America have warm summers but very cold winters.

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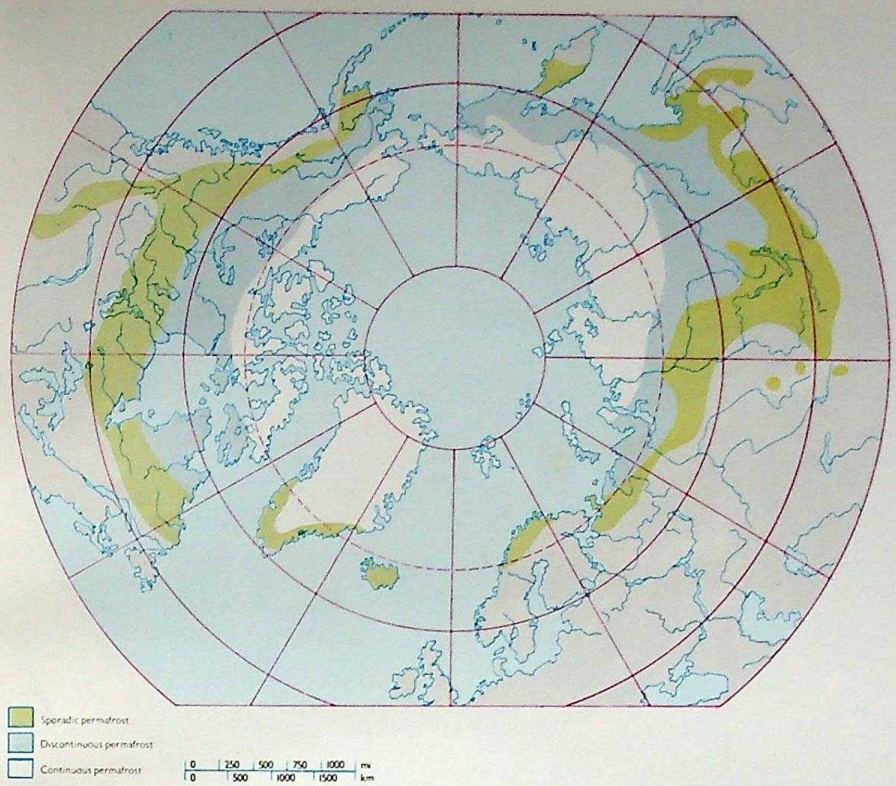

The distribution of permafrost – permanently frozen ground – in the northern hemisphere.

Most rain falls in the summer. As we go to higher latitudes the summers get shorter and the winters longer. The typical vegetation is forest of both deciduous and conifer trees. A similar region occurs in eastern Asia, in north-east China and northern Japan. This region is affected by the seasonal monsoon winds.

Cold and Polar Regions

The last regions mentioned are often included in climatic maps in the cold snowy forest zone. This zone extends over a very large area of the world's land masses between latitudes 40° and 60° North. It is a region of coniferous forest land, where logging, or lumbering, is an important occupation. So is trapping of animals such as foxes, ermines and beavers for their furs. Crop and livestock farming are practised in parts of the region. But in the north the summers are too short and cool and the winters too severe for farming to flourish.

In the north this zone extends nearly to the *Arctic Circle*. This is the 66½°N parallel of latitude. Here the climate is too cold even for evergreen conifers. The landscape consists of flat and featureless plains, called *tundra*. It is covered with mosses and lichens. Here and there stubby bushes may grow. In summer favourable spots are carpeted with beautiful flowers. But the summers are very short, and the temperature never rises above 10°C (50°F). The long winters are very cold. The ground is frozen for much of the year. Only a thin top layer thaws. The rest, called *permafrost*, remains permanently frozen. There is little precipitation, and what there is falls mainly in the winter as snow.

The region is very sparsely populated – in North America by the Eskimos and in Europe by the Lapps. Eskimos live by hunting seals and catching fish. The Lapps herd reindeer, which can withstand the cruel climate. Large herds of caribou roam the tundra.

Most of Greenland is a highland permanently covered with ice. Even in summer temperatures never rise to freezing point and in winter they regularly plummet to 50°C below zero (−60°F). This type of climate is often called *polar highland*, or *ice-cap*. No vegetation exists. Animal life is found on the coasts and in the sea. Notable are the penguins in Antarctica and the polar bear in the Arctic. Whales live in both Arctic and Antarctic waters.

Polar-type climates are also found in other regions of the Earth, where the altitude is high enough. The towering mountains of the Andes in South America and the Himalayas in Asia have a polar climate above a certain level. Near their peaks, the mountains have a typical ice-cap climate. Lower down, but still above the so-called tree line, a tundra-type of landscape may exist.

Pack ice drifting in Arctic waters near Greenland. The constantly changing patterns of ice and open water make ship navigation very hazardous.

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MAN ON EARTH

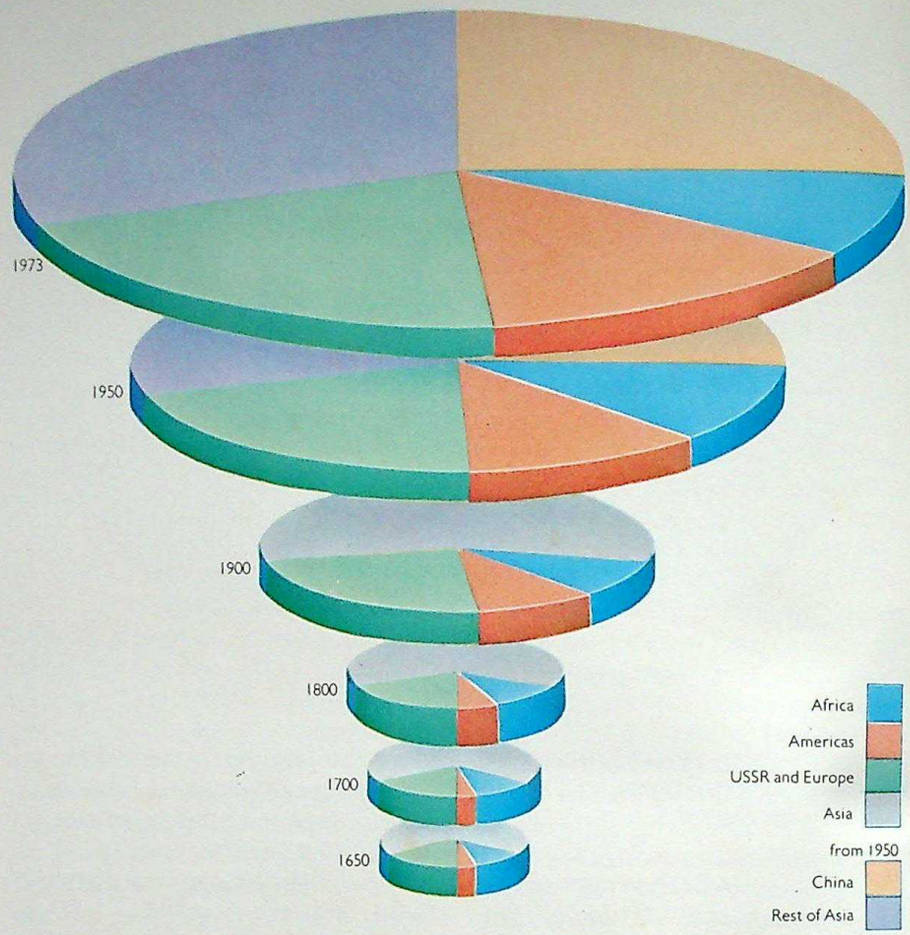
Man is to be found in practically every place on Earth. He lives in the steaming hot jungles of the Amazon basin and in the frozen tundra regions of the Arctic. He inhabits the low plains of the Ganges and the high plateau of Tibet. He is the most wide-ranging of the higher animals. He is intelligent and inventive, and this has enabled him to adapt himself to a variety of *environments* (surroundings).

Early Man was very much a slave to Nature – to climate and to geography. Today Man builds houses with central heating or air-conditioning to insulate him from the climate. He builds machines to transport him quickly from the place in which he lives. To aid communication on land he builds roads and railways, bridging valleys and rivers and tunnelling through mountains.

Whereas early Man relied on gathering and hunting for food, modern Man relies on farming – growing crops and raising livestock. Where productive species (kinds) of crops and livestock do not exist in a region, Man introduces them from elsewhere. He has, for example, introduced wheat, cotton, horses, sheep and pigs from the Old World (Europe and Asia) to the New (America and Australia). He has introduced the potato, maize, pineapple, tobacco and rubber tree from the New World to the Old. Man has, in fact, greatly modified the geography of certain regions by his methods of farming. Introduced crops and livestock have in places replaced the natural vegetation and wildlife. Native forest has been cleared for agriculture and settlements. New species of trees which give a higher yield of timber have often been introduced.

But not all of Man's activities have been beneficial to the world at large. The felling of forests for timber has sometimes led to the erosion (wearing away) of the soil. This has turned fertile land into desert wastes. The factories Man has built to manufacture the things he needs produce dirty and poisonous wastes, which pollute the air and water. The chemicals farmers use to control weeds, pests and diseases also cause pollution. So do the choking, smoky fumes from motor cars and the oil spilt from ships. With all these, and many more things, Man upsets the delicate balance of Nature. The danger is that if he upsets Nature too much, Nature may never recover. Many more species of plants and animals will die out. Even Man himself may become extinct.

The study of Man in relation to his surroundings is often called *human geography*. The scientific study of Man is called *anthropology*. Anthropologists study the different peoples who make up the world's population. They compare the different ways of life and languages. Anthropologists called *ethnologists* study the cultures of different peoples, that is, their habits and beliefs.



This illustration vividly shows the staggering increase in world population that has taken place, particularly since 1900. It also shows how the population has grown continent by continent. By far the greatest expansion has been in Asia.

Archaeology is another branch of anthropology. It concerns the study of ancient buildings and tools used by earlier civilizations. They give clues to the ways of life of the peoples of the time.

Population

The population of the world at present is approaching 4,000 million people. By the year 2000 there could well be more than 6,000 million people. Yet in 1900 there were only about 1,500 million people! Since that time there has been what is termed a population explosion. This has occurred because many more babies are surviving at birth, and people are living longer.

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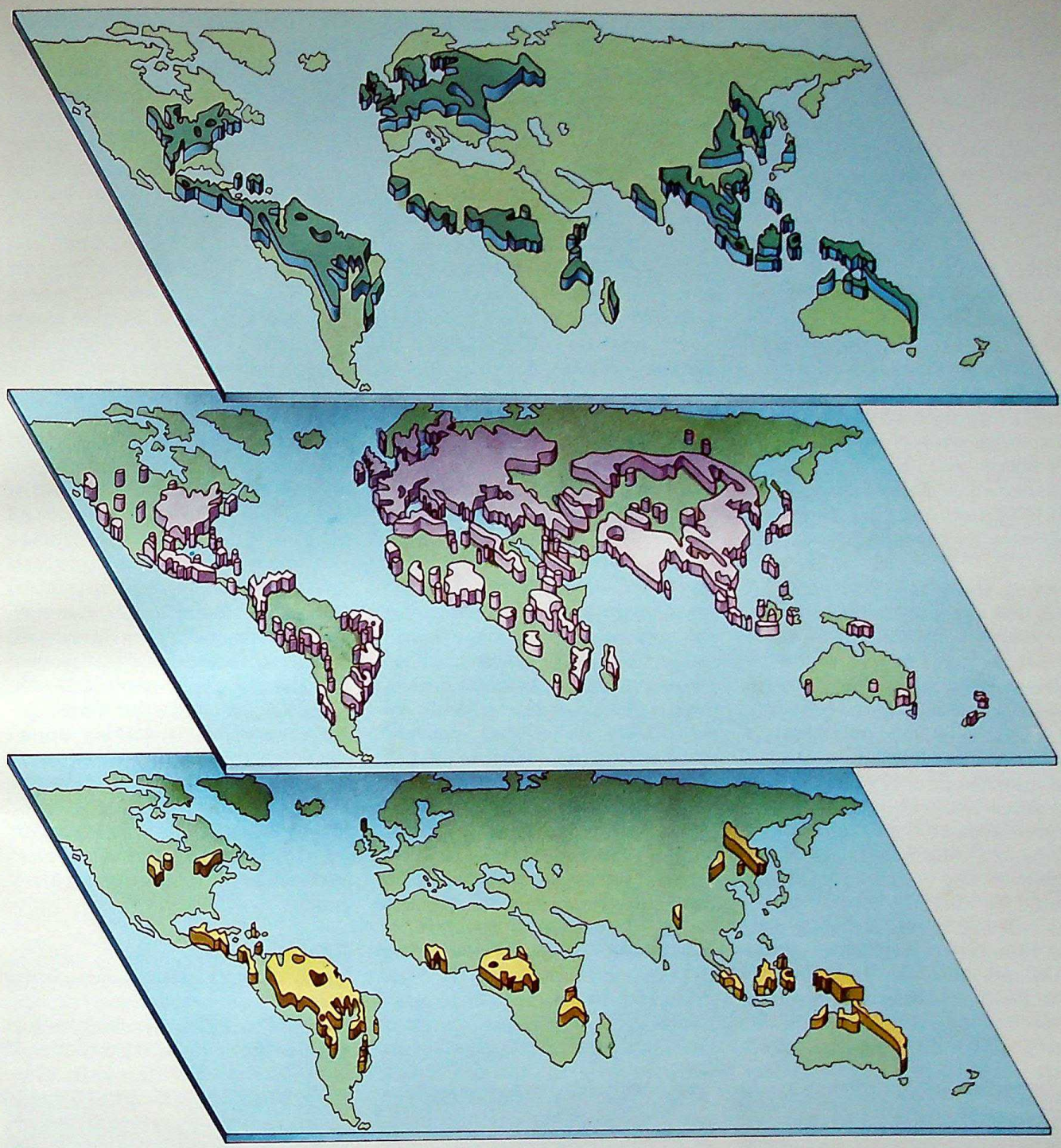

In the above diagram, we can see (A) those areas of the world which are most suitable for Man's exploitation. (B) shows us that he has in fact populated some areas which are not altogether suitable. Even so, (C) shows areas which are still available for agricultural development. South America provides the greatest amount of potential, together with the Congo Basin in Africa and some areas of Australia and Indonesia.

The world's people are not evenly distributed over the globe. The population is densest in four main regions: in the Far East – China and Japan; in India; in western Europe; and in eastern North America. In these regions the average density of the population is over 65 people a square kilometre (170 people a square mile). Together these regions account for three-quarters of the world's population. There are other, smaller, densely populated areas elsewhere, of course – for example, Egypt and Nigeria. In contrast, in the tundra region of the Arctic, the Sahara desert and the Amazon Basin, there is an average of less than one person in every square kilometre (less than one per square mile).

The very hot, the very cold, the very wet and the very dry regions

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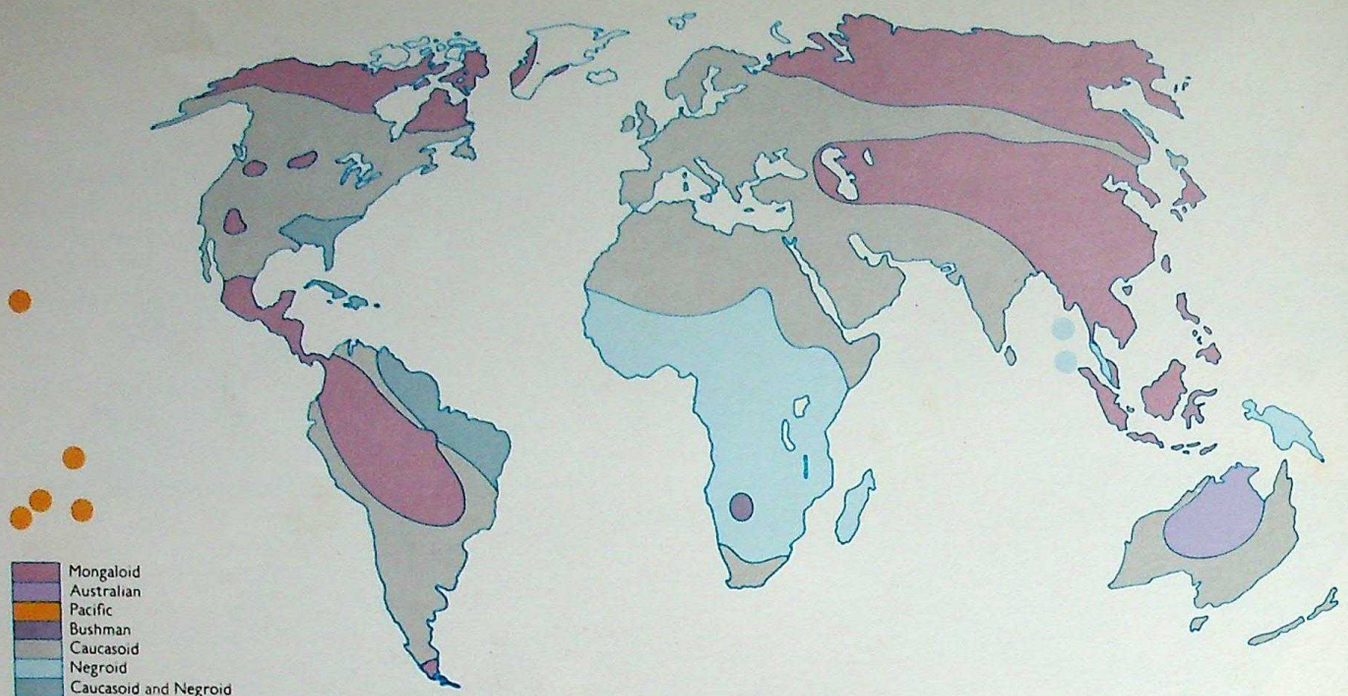

This map shows how the various races of Man are distributed around the world.

of the world are the regions which have the lowest population. The climate in fact is one of the main things which influences where and how we live. We can modify the effect of the climate only to a degree. We could live in the Arctic by building a heated house, but our day-to-day activities would be severely hampered by the cold and snow. We could not, for example, grow food crops or keep cattle.

In general human beings prefer a not-too-warm, not-too-cold climate, where the humidity (moisture content) is fairly low. Very humid, hot weather tends to make us lazy and unable to concentrate. The constant, very high humidity of equatorial regions is positively damaging to the health of most people. This explains mainly why the most densely populated areas are where they are – in the middle-latitude climatic regions.

The availability of water is another factor which influences where Man settles. Most of the world's cities and towns are located on rivers and lakes, or in the lowland areas surrounding water. The Ganges and the Hwang, two of Asia's greatest rivers, flow through fertile plains which have attracted a dense population. The rivers and lakes not only supply water for drinking and watering crops, but also provide a means of communication. Life becomes difficult in regions where rainfall is slight or erratic. Some regions of the world are habitable if the rains come regularly. But if the rains fail, and prolonged drought occurs, the population suffers greatly. This happens often in the lands bordering the Sahara desert. Tens of thousands of people may die every year while the drought lasts.

The relief, or height and ruggedness of the land, greatly influences the pattern of settlement. Most settlement is in lowland areas, where the soil is fertile and communications are good. Mountainous regions are sparsely populated. In general, mountainous areas are usually wind-swept and have poor soils, so crop farming is difficult, if not impossible. Also communications are difficult. The presence of mountains has a marked effect on the climate of the surrounding regions and this in turn affects settlement.

Another great influence on settlement is mineral wealth. Most of the world's densely populated industrial areas are centred on coalfields and iron-ore deposits. The coal provides the source of power, and the iron ore the raw material from which steel is made. The Ruhr in Germany is one of the most highly developed industrial centres in the world. The Great Lakes region of North America is a centre for American industry which is densely populated. It has abundant supplies of iron ore, and coal is available closeby. The Great Lakes provide good communications for shipping the industrial raw materials and manufactured goods.

Races of Man

Every human being differs from every other in one way or another. For example, they differ physically, some are short, others are tall. Some have fair skin, blue eyes and straight blond hair, others have a dark skin, brown eyes and black crinkly hair. Human beings also differ in the language they speak, the religion they follow, and in many other ways. When we classify people, we may do so by nationality (that is, according to the country in which they were born) – for example, they may be German. We may do so be religion – for example, they may be Roman Catholic. Or, we may do so by the language they speak – for example, they may be English-speaking. These are not profound classifications because people may move from one country to

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another, and change their religion and language.

Another way in which people are sometimes classified is in terms of their *race*. This classification is based upon their physical features. These features are passed on to their descendants, unlike their nationality, religion and language. The physical features, or *traits*, which distinguish a race include: colour of skin; shape of head, nose, ears and lips; colour and texture of hair; and, very important today, blood type.

There are three main races, called Caucasoid, Mongoloid and Negroid. The *Caucasoids* are the pink-to-brown skinned peoples with wavy hair – for example, the Europeans. The *Mongoloids* are yellow-skinned peoples, with straight hair – for example, the Chinese and Japanese. The *Negroids* are the dark-skinned peoples with woolly hair – for example, the African Bantus and American Negroes.

Classifying people according to race is not always very easy, nor very useful, however, because many of the peoples of the world have descended from mixed stock. Their physical features show the influence of more than one of the basic races. The distribution of races over the Earth is the result of thousands of years of migrations, or movement of the peoples. Some migrations have occurred because of changes in climate. Many have occurred as a result of military conquests; others because of political or religious persecution.

The Caucasoids

There are several types of Caucasoids, for example, the Nordics, East Baltics, Alpines and Mediterraneans. The *Nordics* are tall, long-headed and blond, with blue eyes. The *East Baltics* tend to be short, with a broad round head and a round face. The *Alpines*, too, tend to be short and stocky, with a broad skull. The *Mediterraneans* have a long head, dark skin, dark eyes and dark, wavy hair. All three types are found throughout Europe. Most Nordics are found in Scandinavia, the British Isles and Germany. Most East Baltics are found, as are the Alpines, in eastern Europe. The Alpines include the peoples called the *Slavs* because they speak a Slavonic language.

Many Mediterraneans are found in the Mediterranean regions. The Arabs are a Mediterranean race with light-brown skin, jet-black hair, a long skull and a sharp, narrow nose. Mediterraneans also form the basic race of northern and central India. The *Hamites* of northern Africa are of mainly Mediterranean stock, with Negroid influence. They are found in Egypt, Ethiopia and Somalia, and in the Sahara and the western Sudan. Other Caucasoid peoples include the *Polynesians* of many of the Pacific Islands and New Zealand, the *Ainu* of Japan and the *Veddah* of southern India.

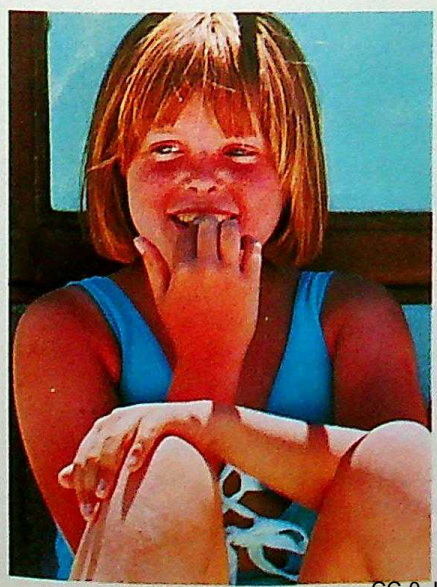
The Mongoloids

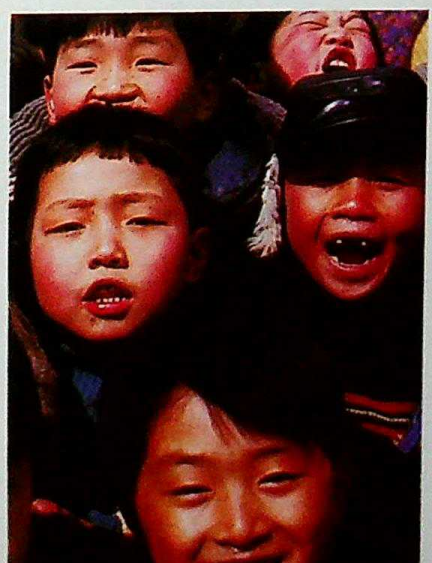
The Mongoloids are a round-headed race with coarse, straight black hair. They have little other hair on their body. Their skin may be yellowish, brownish or copper-coloured. Their nose is slightly broader than the Caucasoid's and the lips are quite thin. The most distinctive feature is the fold of skin which hangs over the upper eyelid. This makes the eye appear slanted or almond-shaped.

Among the Mongoloid peoples are the Chinese, who belong to the so-called *Sinitic* race. The Japanese are a mixture of the Sinitic and Ainu races; other Sinitic mixtures are found in Burma, Tibet and other parts of Asia. The *Mongols* are the Mongoloid people of Mongolia, and are also found elsewhere in Asia. The peoples of South-East Asia are basically Mongoloid, too. They include the Malaysians, Indonesians and Filipinos – the people of the Philippines.

The *American Indians* form a branch of the Mongoloid race. They include not only the so-called Red Indians of the central plains but also the Eskimos of

Children of three contrasting racial groups. Europeans of Nordic stock (below) contrast with Mongoloid North Koreans (middle) and Negroid Nigerians (right).





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A crowd in Calcutta, one of India's biggest cities. India has a rapidly growing population, second in size only to China's.

the North American Arctic and the Indians of Central and South America. The American Indians differ in several respects from the true Mongoloids. They have a brownish to copper-coloured skin. And many do not have the typical fold over the eyes.

The Negroids

There are many woolly haired Negroid groups. The so-called true Negroes are found in Guinea and west Sudan. They are tall and powerfully built. They have a long skull, a broad nose and thick lips. Their skin is dark brown or black. The east Sudanese, who live in the upper Nile valley, are called *Nilotes*. The *Bantu* are a number of peoples speaking one of the Bantu family of languages. They include the Masai, Kikuyu, Zulu, Swahili and Swazi peoples. The Nilotes and Bantu show the influence of the Hamites. Often they have a paler skin and thinner nose and lips than the true Negro.

The *Papuans* are a Negroid group living on the island of New Guinea and on some Indonesian islands. They are fairly short in build, and have longer hair than the true Negro. The Negroid race who inhabit the Pacific Islands are called *Melanesians*. The region is called Melanesia (Black Islands), though the peoples' skins are chocolate brown rather than black.

Pygmies, Bushmen, Hottentots and Australoids

These are races of people who do not fit easily into any of the main groups. Small numbers of pygmies called *Negrillos* live in the forests of equatorial Africa. They are very short. Often a fully grown man may be only about 1.4 metres ($4\frac{1}{2}$ feet) tall. Another group of pygmies, called *Negritos*, are found in parts of Malaysia and the islands of South-East Asia.

The *Bushmen* and *Hottentots*, who live in South-West Africa, are the descendants of the original African race. They are not quite as short as the pygmies. They have a much paler skin than the Negro, with a yellowish tint to it. Their woolly hair is twisted and stands up in knotted tufts.

The Australian *aborigines* are examples of the *Australoid* race. They have certain Caucasoid features, such as wavy hair. But they are very dark skinned. They also have a broad nose and a flat sloping forehead, with prominent brow ridges. It is likely that the pygmies, Bushmen, Hottentots and Australoids will soon merge into the general population.

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MAPPING THE EARTH

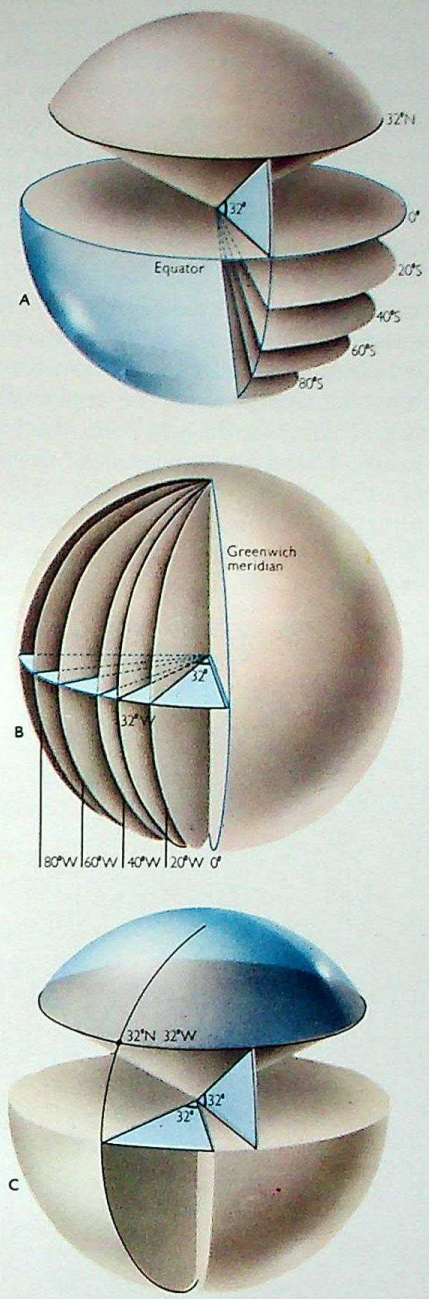
Maps are among the most useful tools geographers use. They represent on a small scale features that appear on the Earth's surface. For example, they show the relative size and shape of the continents and islands. They may show where cities are located. They may show such things as mountain ranges and plateaux, lakes and rivers, and roads and railways.

General reference maps will contain the kind of information mentioned above. General maps covering a small area will probably contain additional information, too; for example, they may show the location of churches, monuments, windmills, archaeological ruins and Roman roads. Maps like this, covering a small area, are known as *topographic maps*.

Most of the maps in this book cover such a large area that they cannot contain general information. They are nearly all specialised maps of one kind or another. Two main kinds of maps are included in the sections on regional geography. They are political maps and physical maps. The *political maps* show the boundaries between the different countries. See the political map of Africa, for example, (page 177). The areas representing the countries are coloured to make them stand out. The capitals of the various countries are shown, together with a few other large cities.

The *physical maps* show the main physical features of the countries. See the physical map of Africa, for example (page 179). It shows mountain ranges, high peaks and plateaux; rivers, lakes and waterfalls; deserts and oases. In addition it is coloured to show regions of different vegetation. So it is a *vegetation map* as well.

Specialists maps are made to display many other kinds of information, including average rainfall, distribution of population, rock types, animals and plants, religions and languages. Another specialised group of maps are those made for use in transport and communications. Motorists use *road maps*, for example, which detail the road network of the region. The maps which ship's navigators use are called *charts*. These show coastal regions in detail and also such things as islands, lighthouses, wrecks, buoys, shallows and water depths.



(A) The latitude of a place on the Earth's surface is measured as an angle north or south of the Equator. This angle represents an angle at the Earth's centre, as shown above. Parallels of latitude can be drawn around the Earth parallel to the Equator.
(B) The longitude of a place is also measured as an angle from a baseline that runs through Greenwich. Lines of longitude, or meridians, circle the globe from pole to pole. They are identified as being west or east of the Greenwich meridian.
(C) Any place is located precisely by giving its latitude and longitude, as you can see.

Map Scales

Most maps are drawn to *scale*. This means that the distance between one place and another on the map is a measure of the actual distance between the two places on the ground. On a *small-scale* map the distance between two places on the map is a small fraction of the actual distance. On a *large-scale* map the distance between two places is a larger fraction. A small-scale map will cover a relatively large area of the Earth's surface; a large-scale map will cover a relatively small area. Most of the maps in this book are small-scale maps.

Most maps have the scale marked on them in one way or another. A common way is as a line with distances marked off along it. Look at the bottom of the North America map, for example (page 197). This shows a scale marked in 200s of kilometres. To show how this works, we shall take an example. Let us find the distance between Sacramento and Salt Lake City. All we have to do is to mark off the distance between the two cities on the edge of a piece of paper. Then we compare this distance against the scale. We find that the distance is about 800 kilometres (500 miles).

You will notice on the map the scale is also marked as 1:40,000,000. This is called a *representative fraction*. It means that the map represents a reduction in size of 40,000,000 to one. In other words 1 centimetre (or inch, for that matter) on the map represents 40,000,000 cm (or inches) of the Earth's surface. Put another way: 1 cm represents 400 kilometres, or 1 inch represents

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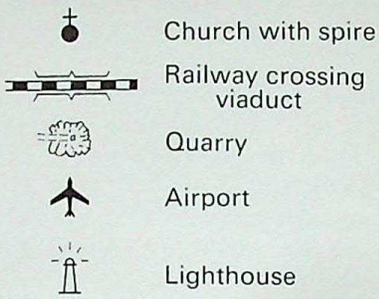
631 miles. We can say that the scale is 400 km to the centimetre, or 631 miles to the inch.

To find the distance between, say, Anchorage in Alaska and Kingston in Jamaica, simply measure off the distance on the map with a ruler. It comes to 18 cm. So we know that this represents 18 × 40,000,000 on the ground, which equals 7,200 km. So the distance between Anchorage and Kingston is 7,200 km. Let us check the distance between Sacramento and Salt Lake City by this method. The ruler shows a distance of about 2 cm, which is equivalent to 2 × 40,000,000 cm, or 800 km. This agrees, as it should, with the other figure.

Another scale is used for the Europe map (page 105). It is 1:20,000,000, or 200 km to the centimetre (315 miles to the inch). The scale is twice as large as that used for the North America map. Motoring maps covering a whole country may have a scale of about 1:1,000,000 or 10 km to the centimetre (16 miles to the inch). A common large-scale map used by walkers and motorists has a scale of 1:50,000 or 500 metres to the centimetre (0.8 miles to the inch). Such a scale is common in Europe. In Britain, maps of this scale have replaced the Ordnance Survey 'One-Inch' maps. These had a scale of 1 mile to the inch, or 1:63,360. The equivalent maps in the United States have a slightly larger scale, 1:62,500.

Displaying Information

Many kinds of *symbols* are used on maps to describe the natural and man-made features of a region. By using symbols map makers can include a great deal of information in the space available. Some of the symbols resemble the things they are meant to represent, others suggest them. For example



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Many different kinds of dashes and dotted lines are used to indicate roads, railways, boundaries and frontiers. Some are distinguished by colour. Abbreviations are also used on maps, such as T for telephone and PO for post office. On some maps the towns are shown by a dot or circle. The size and type of dot may indicate the importance or population of the town. Different lettering and styles of dot may also be used to indicate the size of town as in the political maps in this book:

- ⊙ CITY population over 1,000,000
- ◎ CITY population over 500,000
- ○ CITY population over 100,000
- • City population over 50,000
- ◦ City population under 50,000

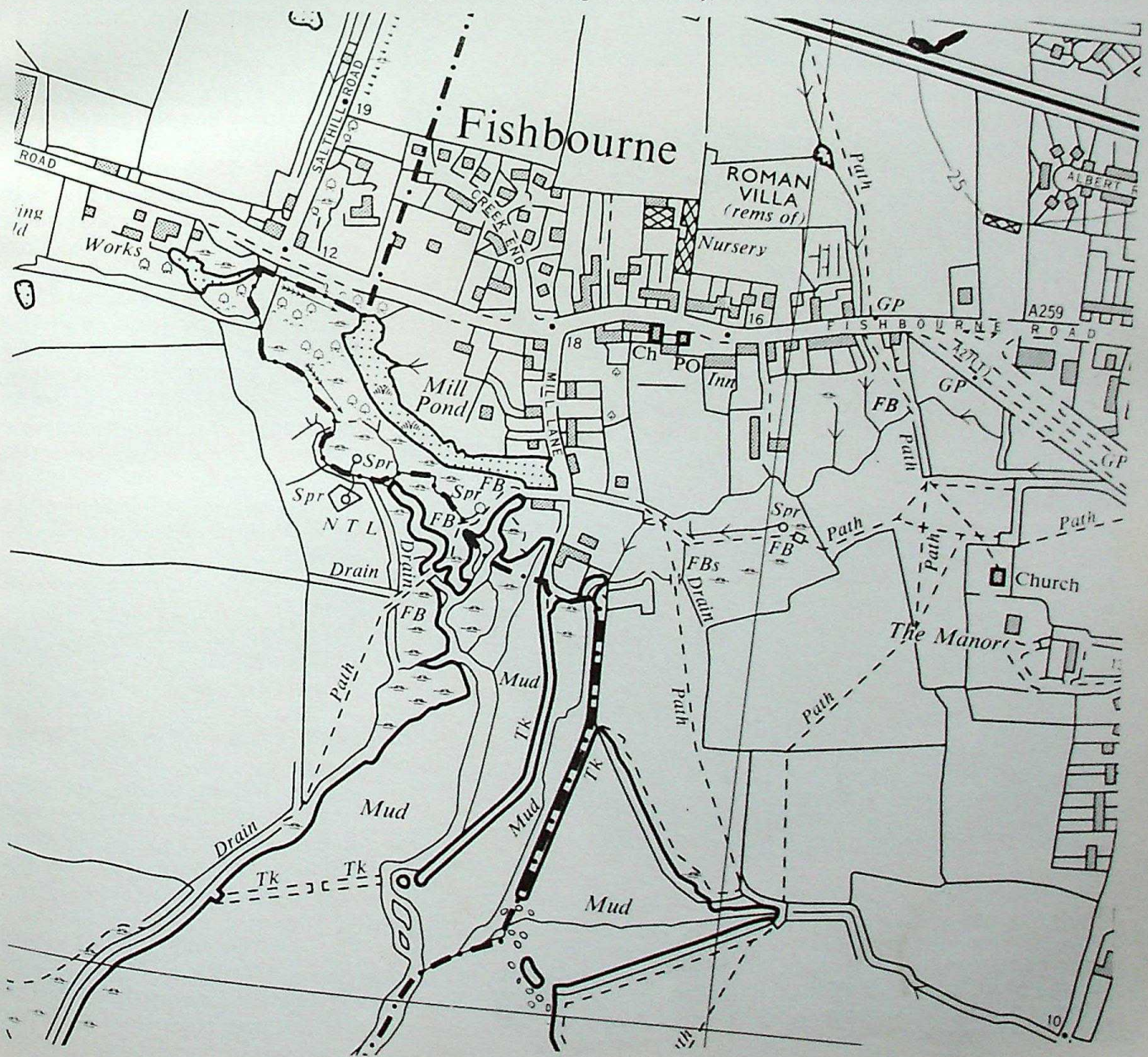
In the Europe map (page 105), for example, we see that Barcelona in eastern Spain has a population of more than 1,000,000; Messina in Sicily, a population of more than 100,000; and Cork in Ireland, a population of more than 50,000. Country capitals are underlined, as at Stockholm.

The kinds of symbols used on a map vary from map to map. On one map + may mean a church without a spire or a tower. On another map it may mean a mountain peak. So to avoid confusion every map has a *legend*. In the legend the meanings of all the symbols used are explained.

Relief

Map-makers have a number of ways of showing the *relief*, or height of the land. The method used in the physical and vegetation maps in this book is *shading*. Look at the Europe map again. Because of shading, we can see at a glance where the mountainous regions are. We can imagine the shading as being the shadows cast by the mountains when a light is shone over the Earth's surface from the north-west.

Below is a map of the area around Fishbourne, in southern England. On the opposite page is an aerial photograph of the same area. Note how clearly the physical features show up. A new road is revealed going to the Roman ruins. Aerial photography now plays a very important part in mapping work. So does photography from Earth satellites.



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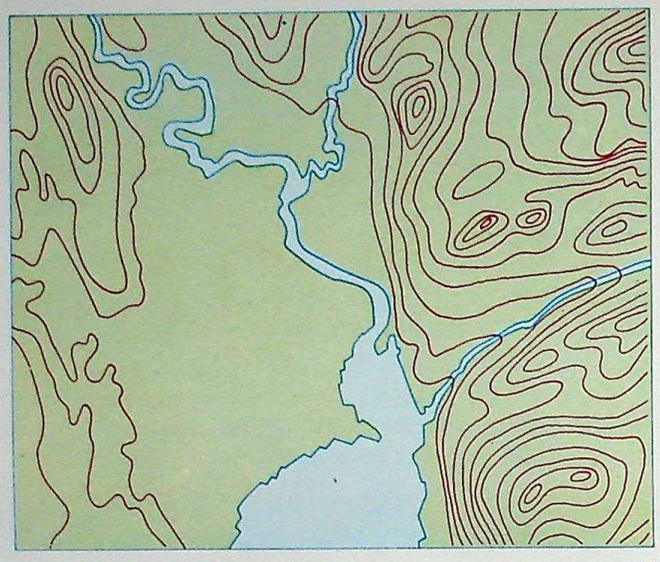
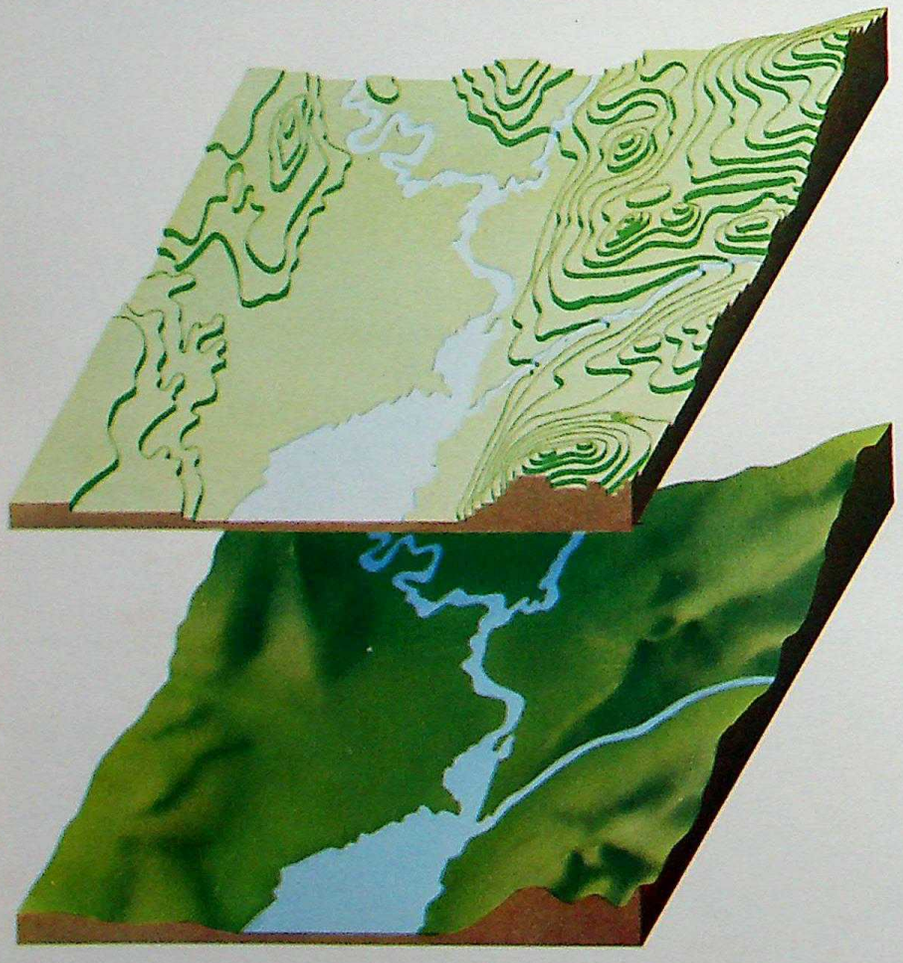
The relief of the land may also be indicated by *hachures*. These are short lines representing the way water would flow down the slopes. They are drawn closer together on steep slopes than they are on gradual slopes. As with shading, hachuring shows the general relief of the land, but not the actual height, or *elevation*.

Contours show the actual elevation of the land. They are continuous lines which join points of the same height. On large-scale maps the *interval* (vertical distance) between two adjacent contours is often 15 metres (50 feet). Thicker lines show larger contour intervals. On gently sloping ground the contour lines are wide apart. On steep slopes they are close together.





One common way of showing the variation in height, or elevation, of the land surface is by means of contours (A). These are lines which join points with the same elevation. From the contours, models can be built up to represent the ground in three dimensions. This may be done by means of layers (B). It may also be done more imaginatively (C). This sort of model has the advantage of giving a more realistic-looking landscape.

Map-makers sometimes use colours to indicate height above sea level. This method, called *layering*, uses different layers, or tints, of colour. For example, dark green may be used to show land between 0 and 100 metres in height; light green for land between 100 and 200 metres; yellow for land between 200 and 300 metres; and so on. Light and dark browns may be used for higher land still.

Map-Making

The art of making maps is called *cartography*, and the people who make them are called *cartographers*. They prepare their maps from measurements and instrument readings taken by people called *surveyors*. They are often helped by photographs of the Earth's surface taken from the air. Making maps with the aid of aerial photographs is called *photogrammetry*. In recent years cartographers have also made use of photographs of the Earth's surface taken by spacecraft. Photographs from the Earth resources survey satellites called *Landsat* have been particularly useful.

The land surveyor uses a method called *triangulation* to find distances on the ground. It is so called because the simple geometry of the triangle is used in calculating distances. What the surveyor does is to divide the ground up into a network of triangles. To begin with he measures a *baseline* between two points, say, A and B. He then chooses a distant point C as the third corner of a triangle. Next he measures the angle between the baseline, AB, and the line from A to C. Finally he measures the angle between the baseline and the line from B to C. From these measurements he can cal-

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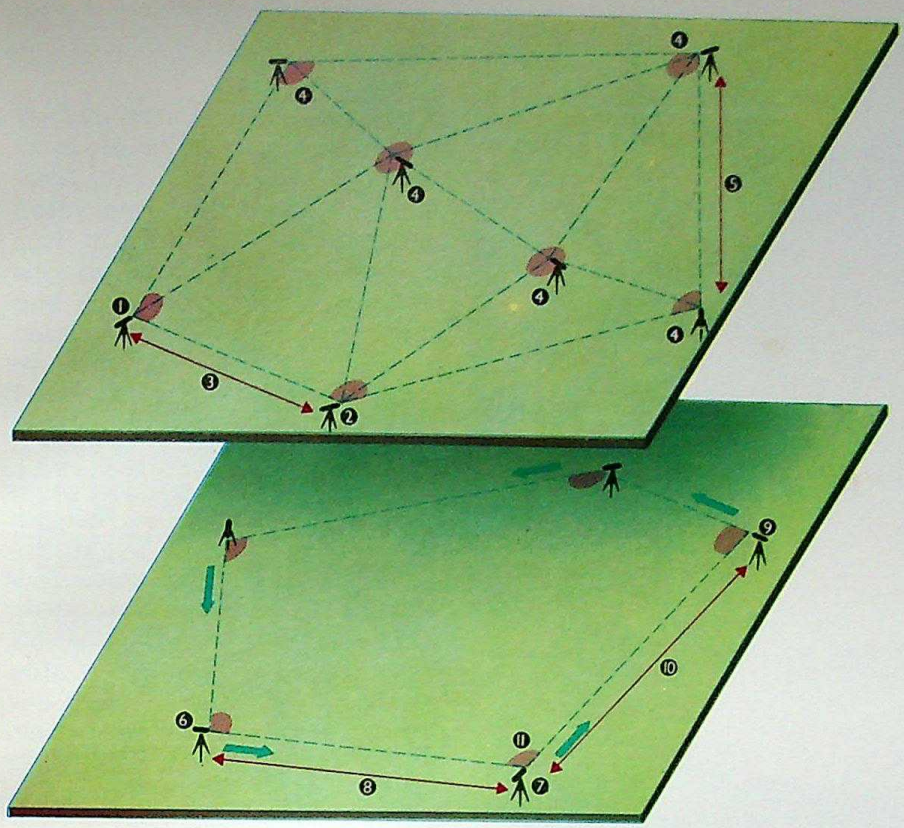

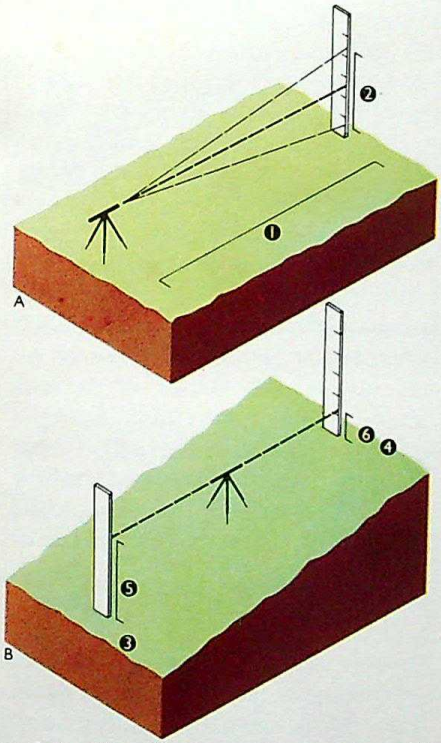

culate the distances from A to C and from B to C. He can then use AC and BC as baselines from which he can measure further triangles.

The surveyor uses an instrument called a *theodolite* to measure the angles from the baseline to the third point. It consists of a telescope mounted on a tripod. The surveyor also uses another instrument widely; called the *level*. It consists of a telescope and a spirit level. He uses it to measure heights accurately.

Above: Simple means of surveying an area. The method illustrated at the top shows the principles of triangulation. First a base line (3) is measured between points (1) and (2). Then bearings are taken of other points (4) from the ends of the base line and in turn from the new points. Eventually a pattern of triangles emerges, as shown. The distances between the various points can be worked out from the simple geometry of the triangles. As a check, the distance between two more points (5) can be measured. The lower picture illustrates what is called a closed traverse. Starting at (6) the distance to another point (7) is measured (8). Then the distance to another point (9) is measured (10). The angles between the lines joining the points are also measured. The process is repeated around the whole area.
Left: The theodolite can also be used to measure distance, as at (A), and height, as at (B). It is used as shown, in conjunction with a ranging pole or measuring stick.

The *compass* is a vital instrument. It is a magnetic instrument, whose needle always points in the same direction. It points to the North and South Magnetic Poles. These Poles are quite close to the true, or geographic North and South Poles. By taking compass readings the surveyor therefore knows the position of the features he is measuring. Compass readings are called *bearings*, and are given in degrees.

After obtaining all the measurements, the map-makers now have to transfer them to a map. This is not as easy as it sounds. The problem is that the surface of the Earth, on which the measurements were taken, is curved. But the surface of a map is flat. For mapping small areas, the curvature does not matter very much. But for making world maps, it does.

On a globe of the Earth are marked lines parallel to the Equator. They are *parallels of latitude*. Circling the globe north to south are lines which are called *lines of longitude*, or *meridians*. Together, the parallels and meridians form a network called a *graticule*. Each parallel of latitude and meridian of longitude is numbered in degrees. Any place on Earth can be located by referring to its latitude and longitude (see below).

The method of transferring the graticule to a flat surface in mapmaking is called *projection*. There are several different kinds of projections. In each one certain ground features will be represented accurately. But others will be distorted. For example, a projection can be chosen which will show either true distances, true shapes, true areas or true directions. But no projection can show all these things at once.

We can picture a projection if we think of a transparent globe with a light inside it. The graticule will cast shadows on a piece of paper placed near it. These shadows would become the graticule of the map. The three most important projections are the

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cylindrical, conic and azimuthal.

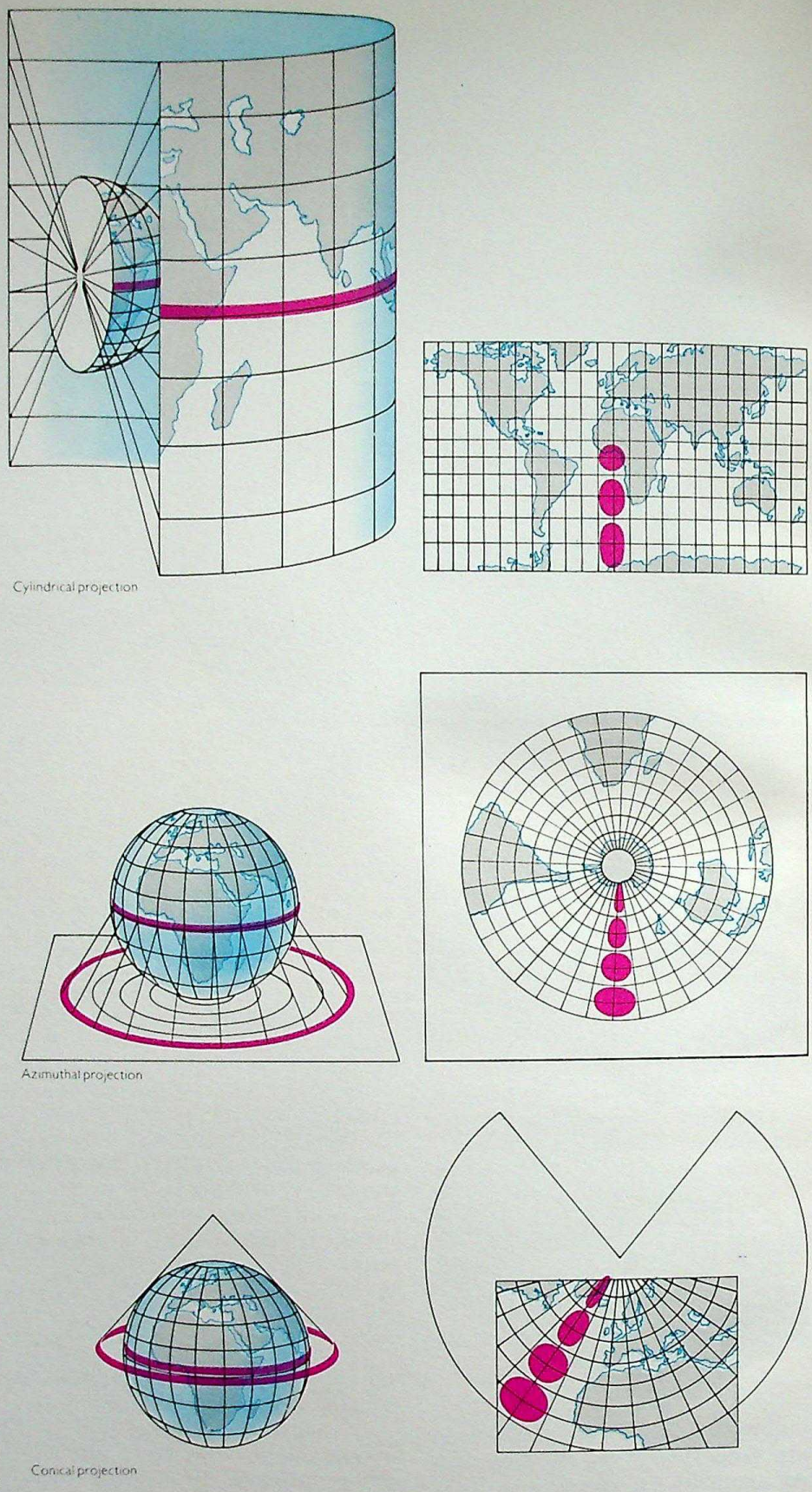
We can picture the graticule of the *cylindrical* projection as the shadow cast by our transparent globe on the inside of a sheet of paper wrapped round the middle of the globe. The well-known *Mercator* projection is a kind of cylindrical projection. In a *conic* projection the graticule casts a shadow on the inside of the paper made into a cone around the globe. In an *azimuthal* projection the graticule casts a shadow on a flat sheet of paper touching the globe at one point.

Latitude and Longitude

Parallels of latitude are numbered up to 90° North or South of the Equator. The Equator is 0°. Meridians of longitude are numbered up to 180° East and West of the meridian through Greenwich. This is the 0°, or *prime meridian*. Using degrees of latitude and longitude, we can quickly locate any point on the Earth's surface. Look at the North America map on page 197. The city of New Orleans is close to the point where the 30° North parallel of latitude crosses the 90° West meridian of longitude (North America is north of the Equator, and west of Greenwich). So we say that New Orleans is at latitude 30° North, longitude 90° West.

What is at latitude 40° North, longitude 75° West? The figures of latitude are given at the sides of the map, and the figures of longitude at the bottom. Longitude 75° West is midway between the 70° and 80° meridians. If you follow the 40° line across and the 75° line up, you find Philadelphia. What is at 45° North, 100° West? What is at 36° North, 115° West?

On many larger-scale maps, such as the 1:50,000 and 'One-inch', another network of north-south and east-west lines, called *eastings* and *northings* respectively, are drawn. They form a so-called *grid*. Places can be located by reference to the grid lines, which are numbered. In a grid reference the number of the vertical easting is usually given before that of the horizontal northing.



Representing the surface of the Earth on a map is not easy. The Earth's surface is curved, while the surface of a map is flat. So there is bound to be some distortion. On a global map the errors can be large. As explained in the text, geographers use various projections to draw their maps. Three common ones are shown here. The cylindrical projection (top) results in an enlargement of areas near the Poles. In azimuthal (middle) and conical (bottom) projections the polar regions are represented smaller than they should be.

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A SLICE THROUGH THE EARTH

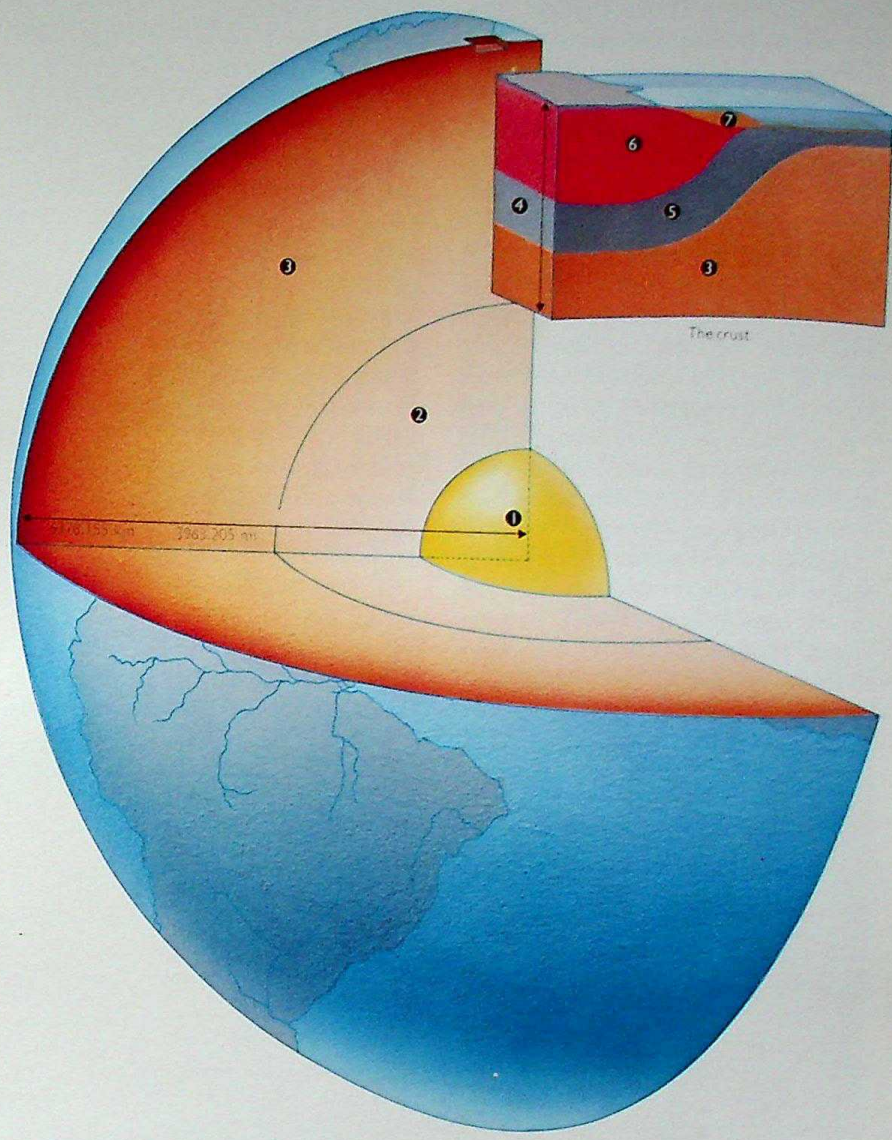
We can examine the structure of an apple by cutting it in half. A very thin skin covers a thick, fleshy part, and there is a hard core in the middle. If we could slice through the Earth, we would find something similar. On the outside is a very thin skin, which we call the *crust*. Then comes a large region called the *mantle*, and in the middle is a hard *core*.

The only part we can reach and study is the crust, or rather the top few miles of it. No-one has ever bored deeper into the crust than about 8 km (5 miles). Yet the distance to the centre of the Earth is some 6,370 km (3,960 miles). Although they cannot reach the lower depths, scientists can still tell us something about them. They do so by studying the waves set up in the ground by earthquakes. They find that the crust forms a layer up to about 33 km (20 miles) thick. The mantle goes down to about 2,900 km (1,800 miles) deep. Then comes the core, which is made up of two parts. The outer core forms a layer about 2,220 km (1,380 miles) thick, and the inner core has a radius of nearly 1,290 km (800 miles).

The crust is made up mainly of solid rock. We cannot always see the rock because it is often covered by water, soil and vegetation. But it is never far below the surface. The crust is much thicker under the continents than it is under the oceans. In some ocean regions it may be less than 8 km (5 miles) thick. The continents are chiefly formed of relatively lightweight rocks such as granite. The ocean floors are formed of rather denser rock, mainly basalt. Both of these rest on the yet denser material of the lower crust.

The rock making up the mantle is in a kind of plastic state and can flow. It is this gradual flow that is causing the continents to drift. The outer core is made up of liquid matter. The inner core is solid. This is what we would expect under the enormous pressure exerted by the rocks above it. The core is probably made up mostly of iron and nickel. This would explain the Earth's great weight. It would also explain the Earth's magnetism, for both iron and nickel have magnetic properties. The temperature of the Earth increases steadily with increasing depth. And in the core it could be as high as 4,000°C. This is almost as hot as some parts of the Sun's surface!

Geologists study the Earth's crust in great detail. They find out what it is made of, how it was formed, and how it changes. They class all the different materials that make up the crust as rocks, whether they are as 'hard as rock' or not. Thus they regard soft sand, gravel, clay and mud as rocks, as well as hard granite, limestone and marble.



Geologists think that if they could cut through the Earth, it would look something like this. At the centre is an inner core (1), outside which lies an outer core (2). The core is believed to be made up mainly of iron and nickel and may be partly liquid. Above the outer core lies a great mass of rock, which forms the mantle (3). Above this is a thin layer of solid crust, which is shown in the enlarged part of the diagram (4).

Under both the oceans and the land masses is a layer of basalt (5). Under the continents, the basalt layer is lower down, and on top of it is a thick mass of granite rock (6). On the ocean floors are layers of recent sediments (7).

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ROCKS AND MINERALS

When you look at most rocks, you can see that they are made up of a mixture of different substances. These are called *minerals*. Granite, for example, is made up mostly of crystals of three minerals, quartz, feldspar and mica. But one lump of granite will not usually be the same as another. The three minerals are not always present in the same proportions. The size of the crystals also varies. So does the way in which they are arranged. This is how rocks differ from minerals. Minerals always have the same composition and structure no matter where they are found.

Minerals are made up of one or more chemical elements combined together in simple proportions. Quartz is one of the commonest minerals. It is made up of silicon (Si) and oxygen (O) combined in the proportions 1:2. This gives it the chemical name silicon dioxide, which we can write SiO_2. A great many minerals are *silicates*. They are combinations of silicon and oxygen with various metals, mainly aluminium, iron, calcium, sodium, potassium, and magnesium. Feldspar, for example, is a potassium aluminium silicate. Together silicon, oxygen and the six metals mentioned above make up 98 parts in every 100 of the Earth's crust. 84 other elements make up the remaining two parts. (There are a further 14 elements, but these have been made by nuclear scientists. They do not occur in nature.)

The elements in a mineral are combined together in a regular pattern. This often gives rise to a distinctive external shape, which we can see when the mineral forms a crystal. Rock salt, for example, has cubic crystals, with six faces. Diamond has eight-sided crystals; calcite has long six-sided crystals ending in a point, rather like a sharpened pencil. Many crystals are very beautiful. And they can be cut with many facets (faces) so that they gleam and sparkle even more. The finest ones are prized as *gems*. Diamond, ruby, sapphire and emerald are the rarest and most expensive gems.

The most important minerals economically, however, are the *ores*. These are the minerals that can be processed to give metals. Only a few metals are found native, or in metal form, in the earth's crust. They include the precious metals gold, silver, platinum and copper. Most metals are found combined with other ele-

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Above: These chalk cliffs on England's Sussex coast show clearly the layered structure typical of sedimentary rocks.
Left: Stalactites hang from the roof and stalagmites rise from the floor in the Carlsbad Caverns, New Mexico. They have been created by dripping limey water.

ments in minerals. Iron ores are by far the most important, for from iron we produce steel. Aluminium ore (bauxite) and copper ores are also very important.

How Rocks are Formed

The thousands of different kinds of rocks that make up the Earth's crust can be divided into three broad classes. This is done according to the way in which they are formed. The three classes are igneous, or fire-formed rocks; sedimentary, or layered rocks; and metamorphic, or changed rocks.

Igneous rocks are formed when molten rock, or magma, from deep inside the Earth forces its way upwards through the crust. If it reaches the surface, a volcano occurs. The magma pours out as a glowing river of lava. As it strikes the air, it begins to cool. If it cools quickly, it forms a jet-black glass called obsidian. No crystals are present because they have not had time to form. If the magma pours into the sea, it cools very quickly and forms a grey porous rock with gas bubbles trapped inside. This is pumice.

When lava cools more slowly on the surface, crystals start to form. But they do not have time to grow very large before the rock sets hard. Basalt is a rock like this. It is dark and heavy, and is made up of a mass of tiny crystals. Sometimes when it cools, it breaks up into a striking structure of six-sided columns. The famous Giant's Causeway in County Antrim, Northern Ireland, is made up of such columns. So is Devil's Postpile National Monument in California, U.S.A.

Sometimes magma from the Earth's interior never reaches the surface. It flows into cracks underground or pushes up rocks above it to form a blister. In both cases it is able to cool slowly. And there is plenty of time for crystals to form and grow. Its crystals of pink or white feldspar, grey quartz, and sparkling mica can be clearly seen. In some granite-like rocks the crystals are huge; these rocks are known as pegmatites. Crystals nearly 6 metres (20 feet) long have been found in some pegmatites.

Many *sedimentary rocks* are formed of material produced when older rocks wear away. When surface rocks are exposed to the sun and weather, they begin to break up. Streams carry the rock fragments away and deposit them in ocean basins and other hollows in the Earth's surface. These deposits, or sediments, build up, layer upon layer, as time goes by. After millions of years the weight of the upper layers compresses the bottom layers into solid rock. Mud, for example, is compressed into the sedimentary rock shale; sand becomes sandstone. Conglomerate is a sedimentary rock formed of rounded pebbles cemented together. It is often called puddingstone, because it looks something like a plum pudding. Breccia is composed of cemented sharp fragments.

Another kind of sedimentary rock is made up of salt deposits. These are left behind when seas of salty water evaporate in the hot sun. By 'salt' we mean not only common salt, sodium chloride, but also other salts, such as calcium carbonate and calcium sulphate. In rock form common salt is called rock salt; calcium carbonate is called limestone; and calcium sulphate is called gypsum.

Some limestone is formed in a different way. It is made up of the

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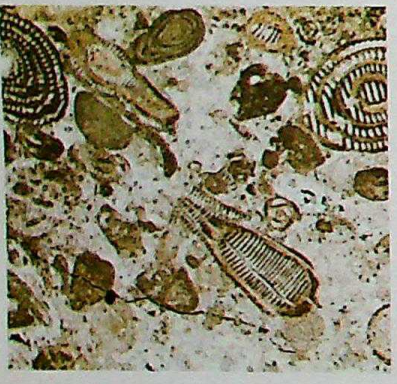
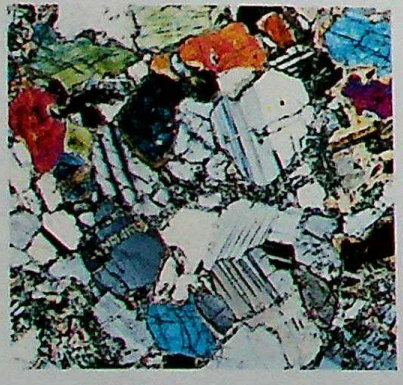
remains of tiny plants and animals. The seas abound with organisms such as coral and shellfish, which have hard shells or skeletons of calcium carbonate. These hard parts fall to the sea bed when the creatures die. Eventually they become pressed into rock. This kind of limestone is called fossiliferous, or fossil-bearing, and the fossils are often easily seen. Pure white chalk was formed in a similar way, but its fossils can be seen only under a microscope. Coal can also be thought of as a sedimentary rock of this kind. It is the compressed remains of giant plants that grew in great swamp forests some 250 million years ago.

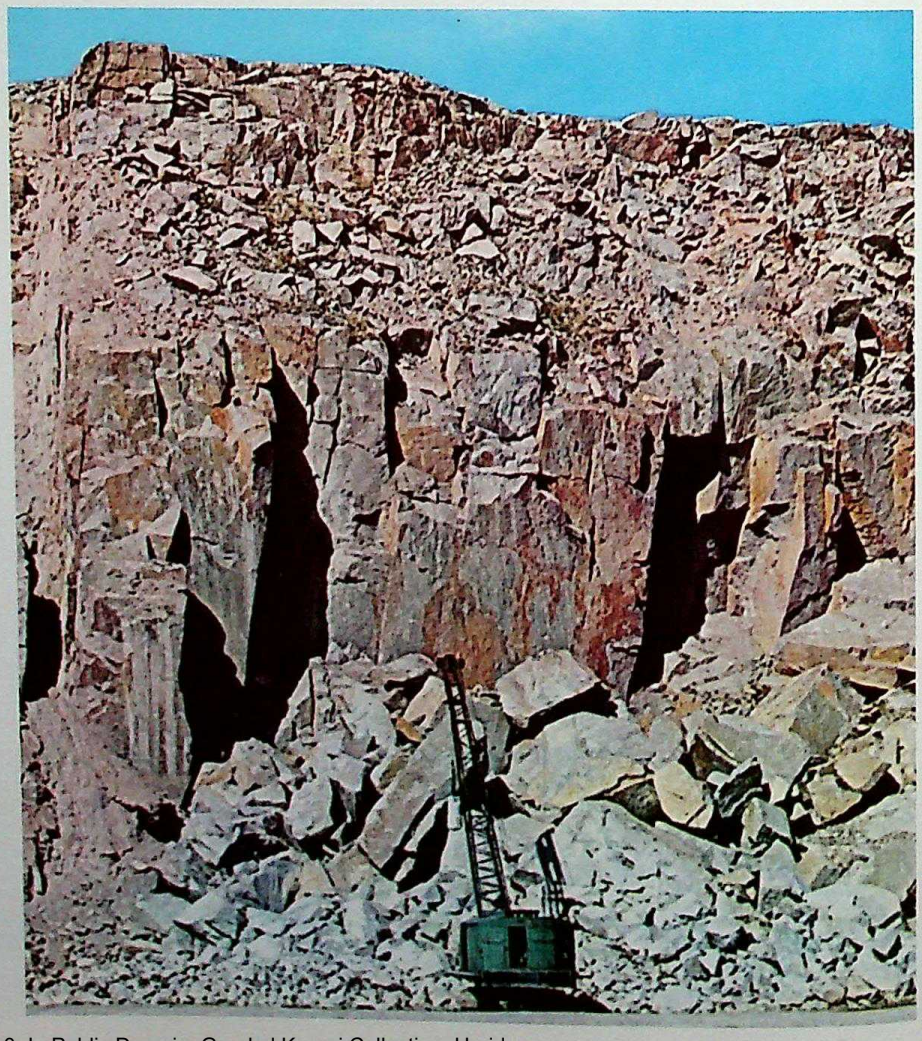
Most of the rocks on the Earth's surface are sedimentary rocks. In most cases we can clearly see different layers, or strata in them, showing how they were formed. But the strata are not always flat. Often they are folded and twisted as a result of movements within the Earth.

The strata of sedimentary rocks may be severely distorted by movements of the Earth's crust. This limestone outcrop shows the kind of fold that results.

The third class of rocks, *metamorphic rocks*, are formed when existing rocks undergo a drastic change deep inside the crust. This change may be brought about by contact with searing hot magma. It may be caused by the chemical action of hot liquids and gases. Or it may result from the pressure of movements in the crust. These changes alter the composition and structure of the original rocks. Often the rocks remelt and form different crystals when they cool. When granite undergoes change, it often becomes a wavy-banded rock called gneiss. Shale changes into flaky slate; and limestone changes into smooth, crystalline marble.







Top: A section of limestone rock made up of fossils.
Above: A thin slice of rock as it appears under a microscope, showing a variety of minerals.
Right: Granite being extracted from a quarry. It is used in building work and road-making.

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THE CHANGING LANDSCAPE

The landscape of the Earth has been shaped, and is still being shaped by natural forces. These forces may bring violent, sudden changes or gentle, more gradual ones. Violent changes occur as a result of movements of the Earth's crust. Such movements cause mountain ranges to form, earthquakes to occur, and volcanoes to erupt. Volcanoes are common in certain regions of the world and can greatly alter the landscape in a short while. For example, in 1943 in Mexico, the volcano Parícutin suddenly appeared. It grew 2,745 metres (9,000 feet) high in a few years.

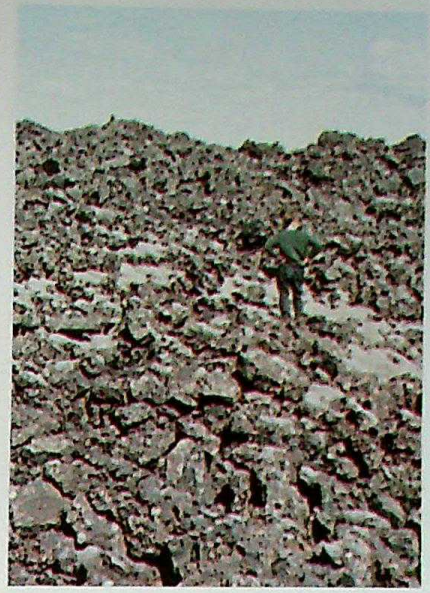
A great many other forces are at work altering the Earth's surface. But their action is more gentle. They are forces of *erosion*, which gradually wear away and destroy the surface. In general what happens is that the action of the weather breaks down the surface rocks. Then water, wind, or some other agent collects and carries the broken rock fragments away. Finally it deposits them in another place.

Weathering

The weather may wear away rocks in several ways. Drastic changes in temperature can do it. By day, in the Sun, rocks can get very hot, while at night they may become very cold. They expand as they are heated and contract as they get cold. And this in time can cause the rock to shatter. Frost can do so too. When water in rock crevices turns to ice, it expands. It may exert enough pressure to split the rock. You can see piles of rock fragments shattered by frost at the foot of many mountains. They are called *scree*.

Rain is a powerful weathering agent. It can wear away soft rocks such as clay by beating against them. It can dissolve some rocks, including limestone. Damp air may also attack rocks, causing them to decay. Old stone buildings show such decay. Animals and plants often assist the weathering process. Animals may burrow into and enlarge crevices. The roots of plants may grow into crevices and act as wedges to force the rock apart.

The wind can have a powerful action, too. In desert regions it sweeps the sand into hills, or dunes. The dunes often change their position and shape from day to day. When the wind carries sand, it has a sand-blasting effect on rocks in its path.

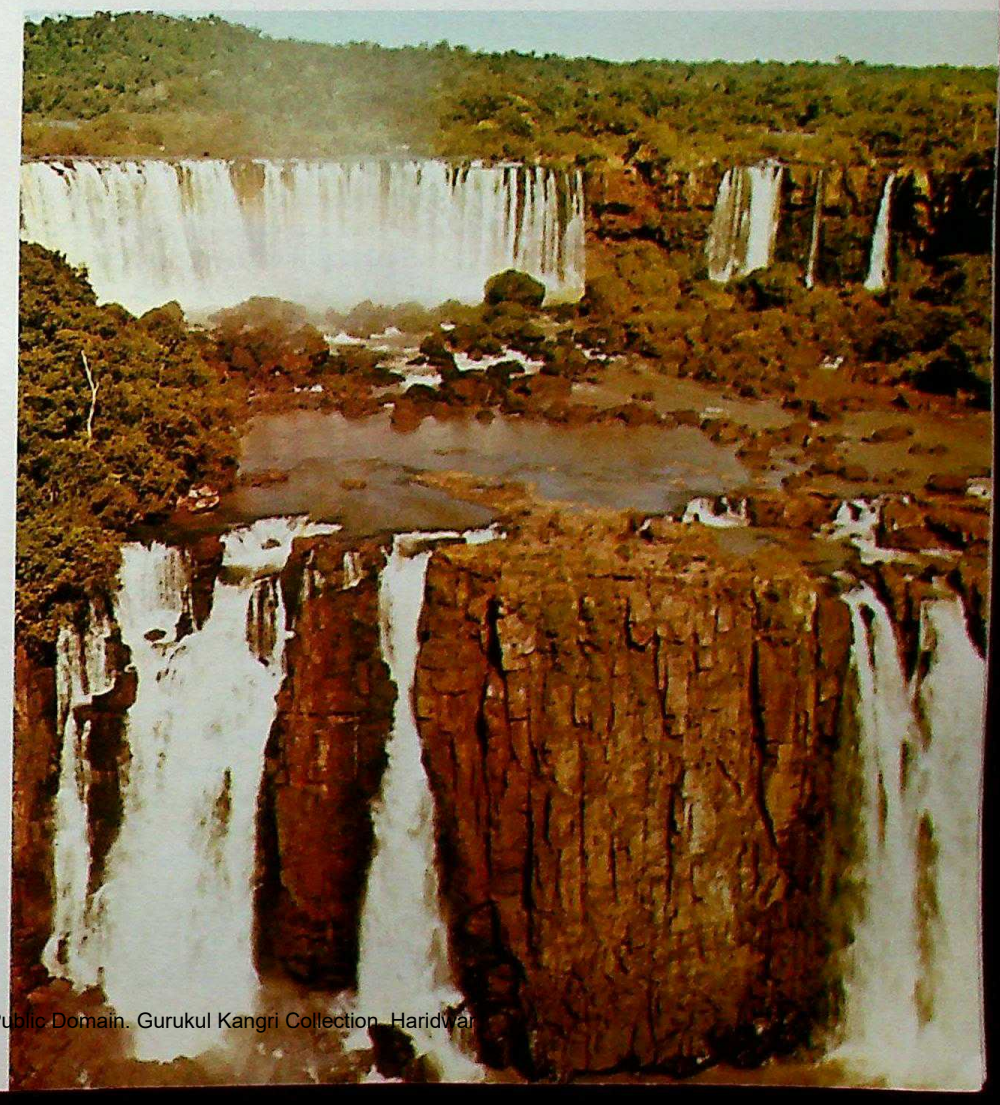


Above: A large field of cindery block lava in Iceland, which has been eroded very little.
Below: The Iguaçu Falls in Brazil. Swift-flowing water is one of the most powerful agents of erosion.

Groundwater

When rain falls on the land, some of the water runs along the surface to form streams and rivers. This is called running water. Some rainwater soaks into the ground, and is called *groundwater*.

Groundwater will seep gradually downwards through the soil until it meets rock. Some rocks are *porous*, or full of pores (holes). They let water flow through them. Other rocks are non-porous, or



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Geyser Basin in Yellowstone National Park, USA, is noted for its hundreds of hot springs and spouting geysers, which can shoot water 60 metres into the air.

impervious. They will not let water through. Groundwater therefore flows downwards through soil and porous rocks until it meets a layer of impervious rock and stops. Up to a certain level the porous rocks become saturated, or completely full of water. This level is called the *water table*. It is the level at which water would be found if you sank a well into the ground.

In some regions groundwater becomes trapped in porous rocks which are sandwiched between impervious rocks. And the water-table may actually be above ground level. If a well is bored through the impervious rock cap, the water may be forced to the surface by the pressure of the groundwater. When this happens, it is called an *artesian well*.

Often in hilly regions the groundwater flows down through the porous rocks and along the impervious rock layer. Eventually it breaks through the surface in the form of a *spring*. In some parts of the world hot springs occur. This happens particularly in volcanic regions, where the ground water comes into contact with hot rocks underground. Sometimes the hot water erupts from the ground as a *geyser*. Iceland and the North Island of New Zealand are well-known for their geysers and hot springs. So is Yellowstone Park in the United States. In this Park is the famous geyser Old Faithful, which erupts regularly for about 4 minutes every 65 minutes.

Springs often occur at the foot of chalk and limestone hills. Chalk and limestone are different forms of the mineral calcium carbonate, and are very porous. They also tend to dissolve in the water that flows over and through them. In limestone regions streams often end abruptly and disappear underground in swallow-holes, or pot-holes. They travel underground through cracks in the rocks, enlarging them as they go. In some regions huge caverns have been formed in this way. The famous Mammoth Cave in Kentucky, USA, is part of a network of some 300 km (200 miles) of caves and tunnels. In limestone caverns constantly dripping water has created spectacular columns. Some hang down from the roofs (*stalactites*); others rise up from the floor (*stalagmites*).

Running Water

Rivers play the most important part in shaping the landscape. They wear away the land and transport and deposit the material they have worn away. The path, or course, of most rivers follows a similar pattern. They begin, or rise, in highland areas. They then flow through more gently sloping land, and finally across a fairly flat plain and into the sea. Rain falls on the hills and mountains and collects in streams that rush headlong down the steep slopes. The rushing water picks up bits of sand and rock which help wear away the stream bed. After centuries of this constant erosion, steep-sided valleys, or gorges, form. Any branches, or tributaries, of the river are short and swift-flowing.

As the river leaves the highland areas, it enters its middle course. The slope of the land becomes less, and the river flows more slowly. Erosion of the bed still takes place, though it is not as rapid as in the highlands. The river no longer takes a straight course, but starts to *meander*, or weave from side to side. A much wider and flatter valley develops in this part of the river's course.

As the land becomes flatter, the river enters its lower course. It becomes wider and flows ever more slowly. It begins to meander in great loops. The valleys it makes are wide and shallow. It flows so slowly that it deposits a lot of the material it has carried from the upper reaches. This material is called *alluvium*. When

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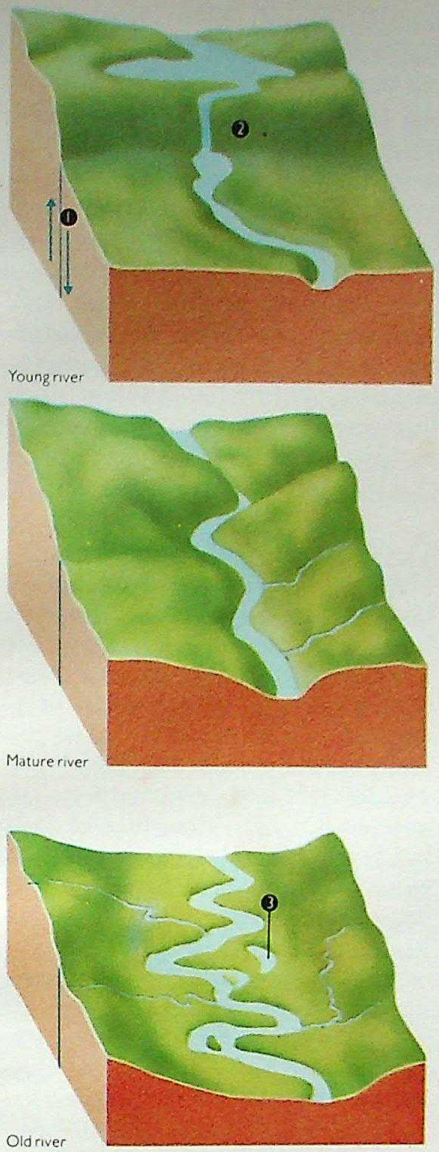
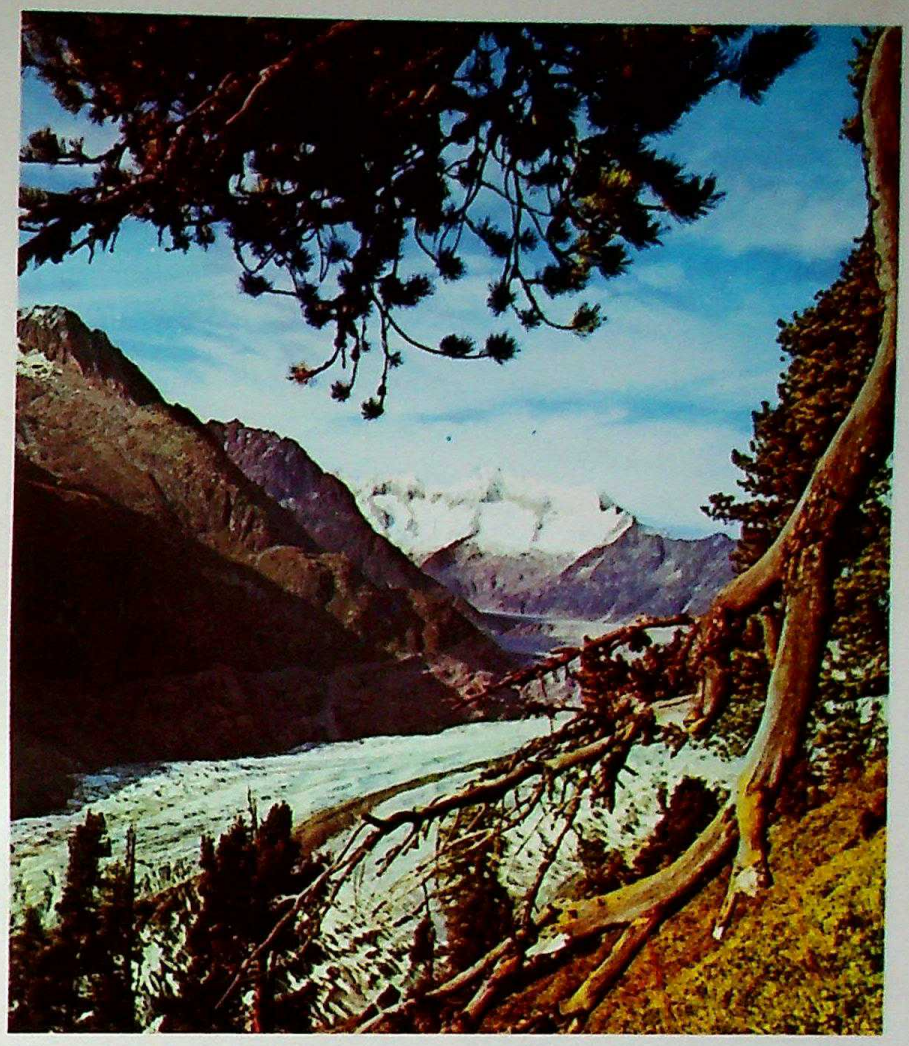


Rivers undergo changes as time goes by, and may be described as being young (top), mature (middle) and old (bottom). In the top picture a geological fault (1) has caused a sharp change in the river bed, and a waterfall (2) has developed. As the river matures, the river valley widens. In old age the river meanders broadly and deposits much sediment. Sometimes little lakes are formed (3).

the river floods, alluvium is deposited over a wide area on either side. Such *flood plains* are very fertile, and provide excellent agricultural land. Examples are the great flood plains of the Mississippi and the Hwang. When rivers reach the sea, they quickly deposit the material they are carrying. These deposits may build up to form what is called a *delta*. Most of the world's great rivers have large delta regions, including the Nile, Mississippi, Amazon, Ganges, and Rhine.



The Greater Aletsch glacier, in the Swiss Alps, is 16 km long and more than 1½ km wide.

The Sea

The sea is a powerful agent of erosion. It is in constant motion. The tides come and go twice a day, and the waves pound ceaselessly against the shore. The waves carry with them sand and pebbles which help grind the rocks away. When driven by the wind in stormy weather, waves can have devastating power.

The action of the sea often causes caves to form at sea level. Often the sea so undermines coastal cliffs that they eventually give way. The rate at which coastlines are worn away by the sea depends on the hardness of the rocks there. Inlets, or bays, are formed when the sea erodes soft rock between harder, more resistant rock. The harder rock forms headlands. In some coastal regions erosion is taking place at a rate of as much as 2 metres (6·6 feet) a year. Near Flamborough Head in Yorkshire, England, nearly 5 km (3 miles) of land have been eaten away since Roman times. Many ancient villages and towns now lie beneath the waves.

As with a river, the sea not only erodes the coastlines. It also transports the material worn away, and deposits it elsewhere. It often deposits sand and pebbles across the mouth of rivers as long *bars* or *spits*. Sometimes these grow to form a continuous barrier and a lagoon is formed behind them. They become the new coastline.

Glaciers

In some parts of the world snow may lie on the ground throughout the year. This happens in polar regions and on very high mountains anywhere on Earth. Often the snow builds up layer upon

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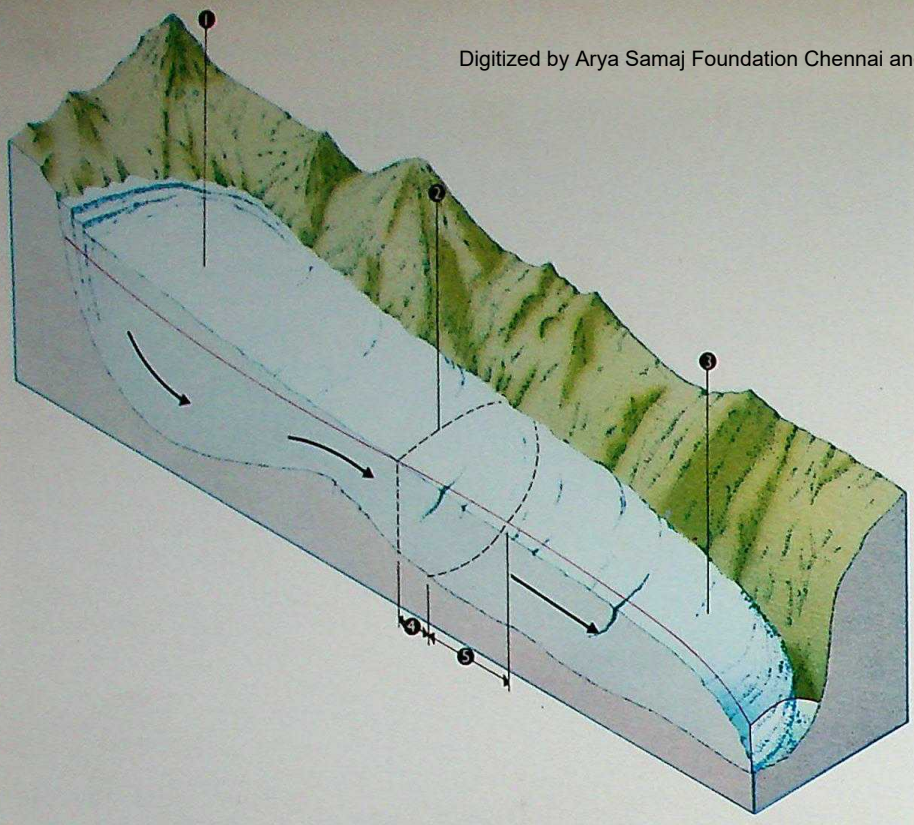


Glaciers gradually move down the valleys in which they formed. In the diagram above, ice builds up at the head of a glacier (1). At about point (2) ice is being lost through melting and flow. Most loss occurs at (3). The glacier flows because it slips on the rocks beneath (4). It also flows internally (5).

Below: It is interesting to note that if the ice in the polar ice caps were to melt, most of Europe's capital cities would be submerged. The sea level would rise by about 80 metres. Parts of London (right) could be 50 metres under water.

layer, and the bottom layers become pressed into ice. This ice gradually begins to move down the valleys under its own weight. It becomes what is called a *glacier*. As it flows down through the mountains, other glaciers may join it, rather as streams join to form a river.

Many glaciers in the Alps move quite slowly, often less than half a metre (between 1 and 2 feet) a day. In Greenland, however, some glaciers travel as fast as 15 metres (50 feet) a day. As glaciers move along, they pick up rocks and pebbles and become rather like a very rough file. They scrape the surface over which they pass, removing any soil and smoothing the rocks. They also wear away the sides of the valley.

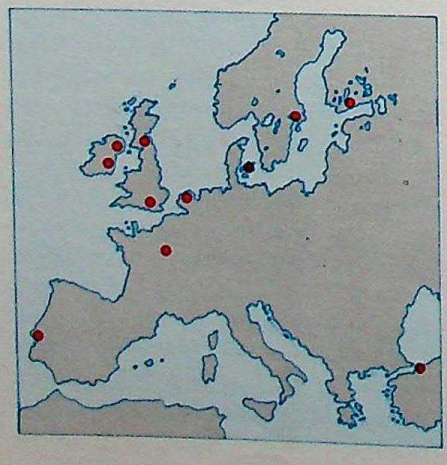
The material a glacier gouges out piles up in ridges near the sides of the valley, forming *moraines*. Moraines also form in the centre when two glaciers merge, and at the foot of a glacier when it melts. Glaciers melt in temperate and hot countries when they reach lower altitudes, where the temperature is higher. They become the source of rivers. The Rhône glacier, for example, is the source of the River Rhône. In polar regions, however, the glaciers reach down to the sea. There they break up and float away as *icebergs*.

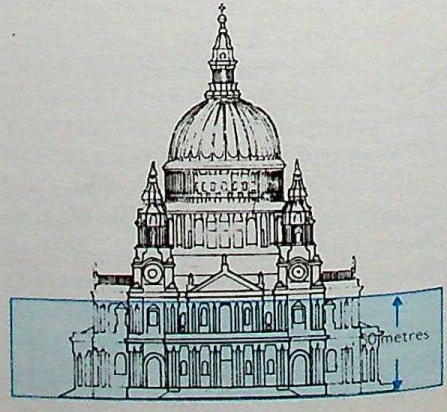
A typical glaciated valley is trough-shaped, with steep sides and a flat bottom. So-called *hanging valleys* occur in many glaciated regions. They occur where tributary glaciers once joined the main glacier. The main one had a more powerful erosive action and became much deeper than the tributaries. When the ice melted, the tributary valleys were left 'hanging', as it were, high above the valley floor. The Lauterbrunnen valley in Switzerland, for example, has many hanging valleys, hundreds of metres above the valley floor.

The Influence of Man

Man himself, of course, also changes the landscape, often drastically. He builds cities, with towering monuments, temples, and skyscrapers hundreds of metres high. He spans valleys, rivers and estuaries with bridges. With explosives and excavators, he gouges out hillsides, fills in hollows, and tunnels into mountains to build roads and railways. He dams rivers to create artificial lakes. He builds artificial rivers, or canals, to take him where natural rivers do not flow.

Man is also an agent of erosion. He has cut down forests for timber and rooted up the hedgerows. In many regions this has allowed the rain to wash away and the wind to blow away the fertile topsoil. Man also destroys the land by his mining operations. Iron ore, coal, asbestos, clay and bauxite are among many minerals often mined on the surface. At the site of underground mines piles of discarded waste material build up to form man-made mountains.





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THE ANGRY EARTH

In August 1883 a small island in Indonesia called Krakatau suddenly exploded. It changed from a peaceful tropical island into a raging volcano, which spat huge lumps of rock 50 km (30 miles) into the air. The force of the explosion was 30 times greater than the biggest hydrogen bomb Man has exploded. The sound of the explosion was heard 5,000 km (3,000 miles) away. The explosion set off a tidal wave that killed more than 36,000 people.

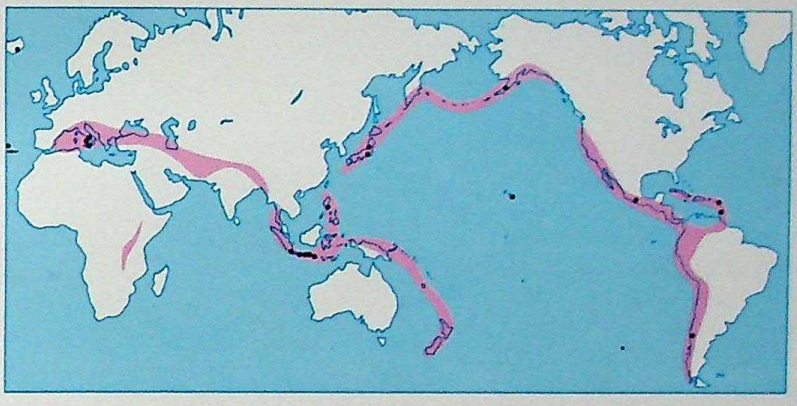
Early one morning in March 1960 in the Moroccan city of Agadir, while most people were asleep, the ground began shaking violently beneath them. It was an earthquake. Within minutes practically every building was a heap of rubble. Thousands of people were killed instantly. Thousands more were fatally injured. The final death toll was more than 12,000. Ten years later 67,000 people were killed in an earthquake in Peru. In 1972 10,000 were killed in an earthquake at Managua, in Nicaragua. More recently (1975) Lice, in Turkey, was devastated.

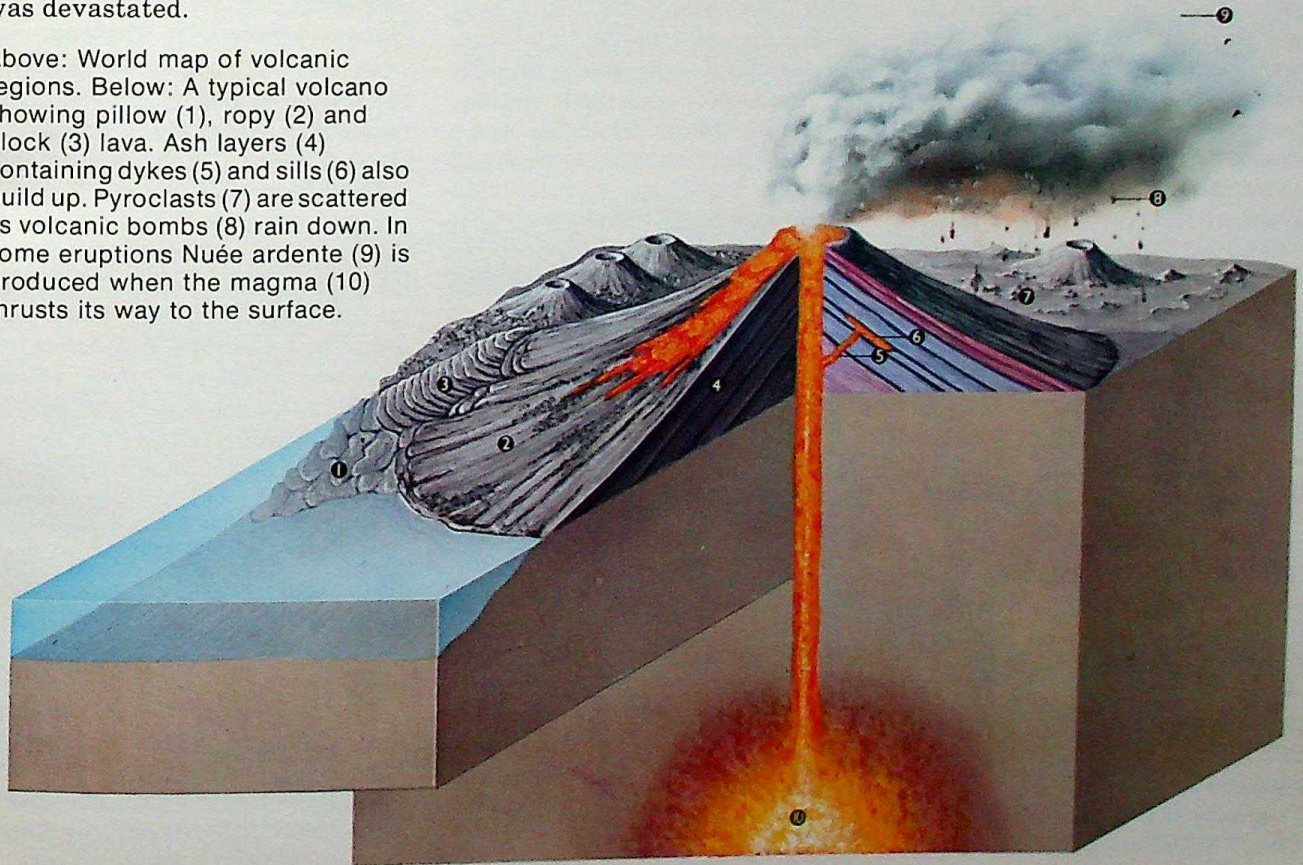
Volcanoes and earthquakes are among the most terrifying things we can experience on Earth. They show that the Earth is still in a very active state.

Ring of Fire

Volcanoes and earthquakes do not occur haphazardly throughout the world. They occur in definite regions, particularly in two great belts. The first is the *circum-Pacific belt*, which girdles the Pacific Ocean. It is often called the 'ring of fire'. It includes the Falkland Islands, the Andes Mountains of South America, the coastal regions of Central America and the United States, Alaska, the Aleutian Islands, the Kuril Islands, Japan, Indonesia and New Zealand. The second great belt extends through the Himalayas, Turkey, the Caucasus, and the Alps. It is known as the *Alpide belt*.

Ancient peoples were naturally terrified of volcanoes and earthquakes. The Japanese thought that earthquakes were caused by the movement of a great spider which carried the Earth on its





Above: World map of volcanic regions. Below: A typical volcano showing pillow (1), ropy (2) and block (3) lava. Ash layers (4) containing dykes (5) and sills (6) also build up. Pyroclasts (7) are scattered as volcanic bombs (8) rain down. In some eruptions Nuée ardente (9) is produced when the magma (10) thrusts its way to the surface.

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back. The Greek mathematician Pythagoras thought that they were caused by the dead fighting among themselves. Today scientists believe that volcanoes and earthquakes occur in areas where blocks of the Earth's crust are moving in relation to one another. These blocks are known as *plates*. The theory of plates also explains how mountains form and why the continents drift (see page 57).

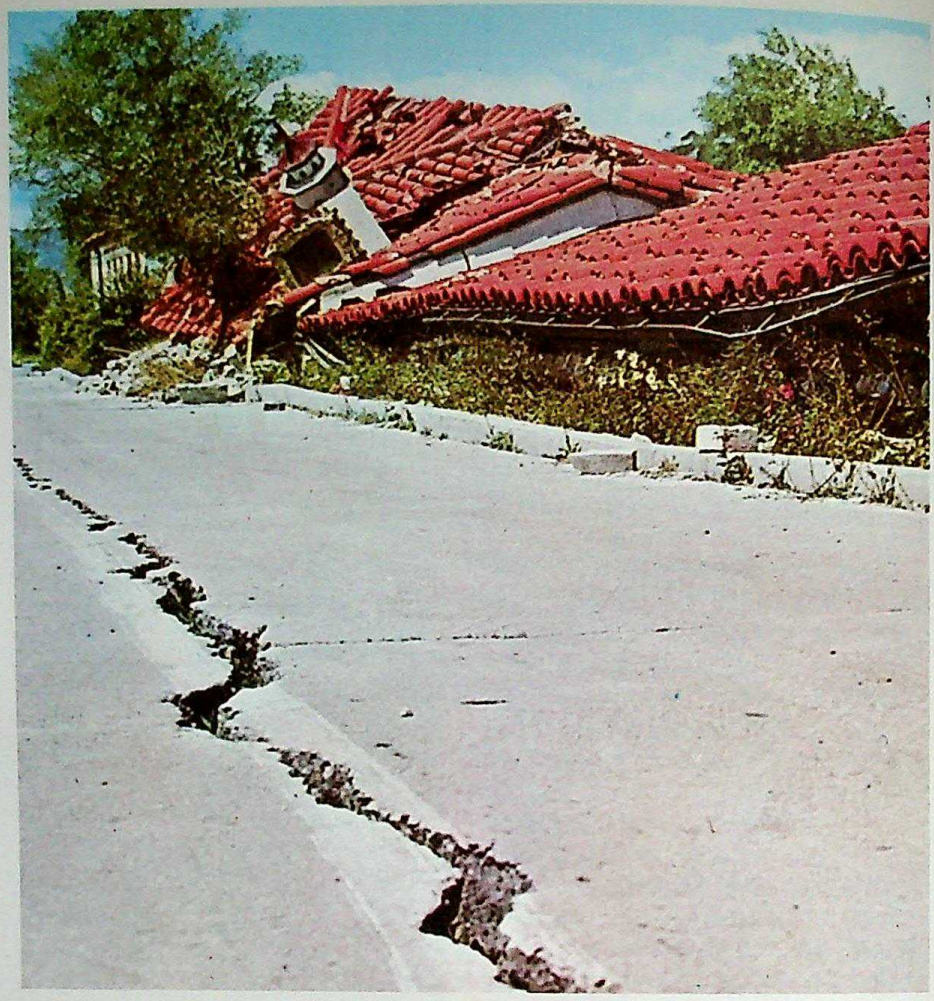
Volcanoes

There are known to be at least 450 *active* volcanoes in the world. Many of them are under the sea. Often volcanoes erupt suddenly with violence and then gradually subside. The crust heals over and in time the volcano becomes *extinct*. Some volcanoes are constantly active. Stromboli off Italy is always active. So is Vesuvius, on the Italian mainland. The Roman city of Pompeii was destroyed in a famous eruption in AD 79. Nearby, Mount Etna, in Sicily, erupts regularly. So does the Hawaiian volcano Mauna Loa. Volcanoes that are at present inactive but could erupt at any time are termed *dormant*.

A volcano forms when very hot molten rock, or *magma*, thrusts its way to the surface from deep inside the Earth's crust. It contains hot gases and steam under great pressure. Sometimes this pressure is so great that it blasts the surface rock high into the air. Magma pours out of the channel or *conduit*, formed by the gas and solidifies into lava when it cools in the air. From time to time the mouth of the volcano may get plugged with lava. Then pressure builds up until the plug is blasted open again. Gradually the lava flows build up, layer upon layer, around the mouth of the volcano. A typical cone shape develops, with a hole, or *crater*, in the centre.

Earthquakes

Every year about half a million earthquakes occur throughout the world. Of these about 100,000 can be felt, and about 1,000 cause damage. Most earthquakes occur at places where the great plates which make up the Earth's crust are moving relative to one another. On the surface such places often coincide with lines that geologists call *faults*. The destructive Lice earthquake of 1975, for example, occurred on the *Anatolian fault*. The American cities of San Francisco and Los Angeles lie close to the *San Andreas fault* in California. This fault is actually visible, and can be traced for some 970 km (600 miles). In 1906 San Francisco was virtually destroyed by a violent earthquake.



Earthquake damage in California, the result of movement along the San Andreas fault. In 1906 San Francisco suffered in this way.

It is thought that many earthquakes take place as a result of two plates locking together. This causes forces, or stresses, to build up in the rocks. Eventually a point is reached when the rocks can withstand no more stress. They suddenly give, and their pent-up energy is released in an earthquake. The ground may move and even split. Shock waves travel outwards from the site of the quake and shake the ground over a wide area. Often it is these waves that cause most destruction. In the Pacific region they set off enormous tidal waves, or *tsunamis*, which can devastate coastal areas.

The place where an earthquake occurs is called the *focus*. It usually lies within about 40 km (25 miles) of the surface. The point on the surface directly above the focus is known as the *epicentre*. The waves set up by an earthquake are called *seismic waves*. The study of these waves is called *seismology*. Large numbers of seismic stations have been set up around the world to detect and measure seismic waves. They have sensitive instruments called *seismographs*, which vibrate when earthquake waves reach them. The epicentre of any earthquake can be found by comparing the time seismic waves take to reach different stations. By carefully studying seismic waves scientists have begun to discover how major earthquakes can be predicted.

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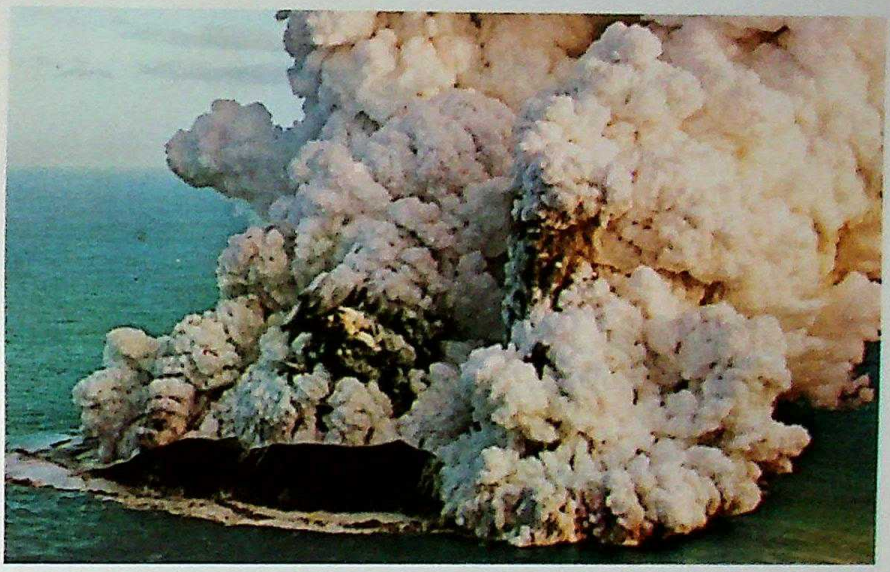
CONTINENTS ADRIFT

The land masses of the Earth look rather like pieces of a jigsaw puzzle. And many of them do fit together quite well. The east coast of South America fits neatly into the west coast of Africa. The coastline of north-west Africa and western Europe fit quite well into the east coast of North America. Eastern Africa, the island of Madagascar, India, Australia and Antarctica can also be fitted together reasonably well. Is this a coincidence? Or could all these land masses have been joined together at one time?

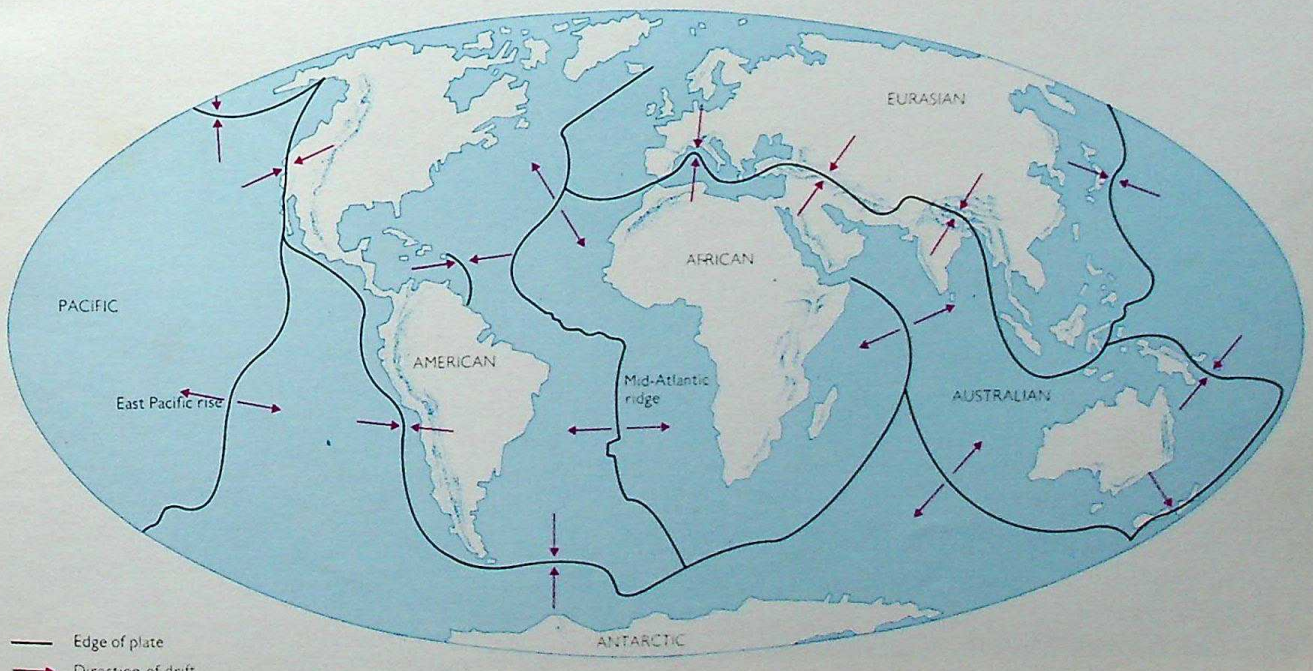
Geologists now think that all the continents were once joined together. They formed the great land mass, or supercontinent, *Pangaea*. About 200 million years years ago, in the Jurassic Period of the Earth's history, Pangaea began to break up into many fragments. These fragments gradually drifted apart until they became the continents we know today. And there is evidence that the continents are still drifting apart. The Atlantic Ocean is widening by something like one millimetre a week. This does not seem much, but think of this continuing for millions of years. At this rate, the Atlantic Ocean could be double its present size in another 200 million years.

Supporting Evidence

The idea of *continental drift* is not new. A German astronomer, Alfred Wegener, put forward the first major theory of continental drift in 1912. But only recently has there been strong evidence to support it. We have already mentioned how the shorelines of the continents are a good fit. This is even more true if we match the broad continental shelves of the continents rather than just the shorelines. Scientists have also found geological evidence which suggests that the continents were joined in the past. They have found, for example, that a belt of



Above: In November 1963 a new volcanic island suddenly appeared to the south of Iceland. It was named Surtsey. Surtsey lies on the Mid-Atlantic Ridge, which marks the boundary between two plates of the Earth's crust. These boundaries are regions of intense volcanic activity.



Below: A world map showing the boundaries between the moving blocks, or plates, which make up the Earth's crust. These plates carry the continents, which are thus gradually 'drifting' towards or away from each other. The direction of movement of the plates is shown on the map.

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ancient rocks along the east coast of Brazil corresponds with one across the South Atlantic in West Africa. They have also found that similar systems of sedimentary rocks are to be found in Africa, South America, Madagascar, India, Australia and Antarctica. Clearly they must have been joined at one time.

It is interesting that the lower layer of the sedimentary system just mentioned resulted from the prolonged action of glaciers. This could only have happened in polar regions. So it appears that countries such as Africa and Australia were once located near the South Pole. Yet now they are close to, or in the tropics!

There is also evidence that the continents were once joined in the fossils found in ancient rocks. Fossils of identical kinds of freshwater fish have been found both in Brazil, South America, and in Gabon, West Africa. Fossils of the same species of amphibian have been found in Africa, Australia, Antarctica, and South America. There is much less similarity in fossils of freshwater or land creatures younger than 200 million years old – the time when the continents are believed to have started drifting into their present pattern.

Yet more evidence of continental drift is to be found in the magnetic 'fingerprints' of rocks. When rocks such as basalt form from molten magma, they become magnetized. And they are magnetized in the direction of the Earth's magnetic field at the time. By studying the direction of rock magnetism scientists have found that rocks on the different continents have different magnetic directions. This again points to the land masses having moved relative to one another.

The Theory of Plates

Continental drift is now explained in terms of *plates*. The Earth's crust is thought not to be solid, but to be made up of a number of blocks, or plates. The continents are fixed to the plates. The plates are about 70 km (45 miles) thick. They are rigid but can move slowly over the mantle on which they rest. The mantle is a thick layer of partly molten rock (see page 57). There are six main plates, which are shown in the diagram.

The edges of the plates are areas of great activity. Some plates are moving together; others are moving apart. When two plates move together, one thrusts down beneath the other. And it remelts in the mantle. Great energy is released, and this gives rise to earthquakes. The remelted rock thrusts up to the surface and gives rise to volcanoes. Where a land mass lies near the edge of one plate, it rises up to form a high mountain range, while the other plate descends. The Andes Range in South America is an example.

Where two plates move apart, molten magma wells up from below to form new crust. This new crust is added to the plates as they move apart. Formation of the new material causes a characteristic double ridge to form. This marks the boundary between the plates. Such ridges can be found in the middle of the Atlantic and Pacific oceans. They are centres for violent earthquakes and volcanic activity. The so-called 'ring of fire' in the Pacific exactly marks the edges of the Pacific plate.

The least violent conflict of the plates occurs when they slide past each other. Only when the plates get jammed, do stresses build up in the rocks. Earthquakes occur when the plates free themselves. The San Andreas fault in California is one region where two plates – the American and Pacific – are rubbing together.

The famous San Andreas Fault in California, USA, which marks the boundary between two plates of the Earth's crust.

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IN THE BEGINNING

How and when did the Earth come into being? These are questions that scientists and philosophers have been pondering for thousands of years. Scientists are now fairly certain when it came into being, but they are not so certain about how.

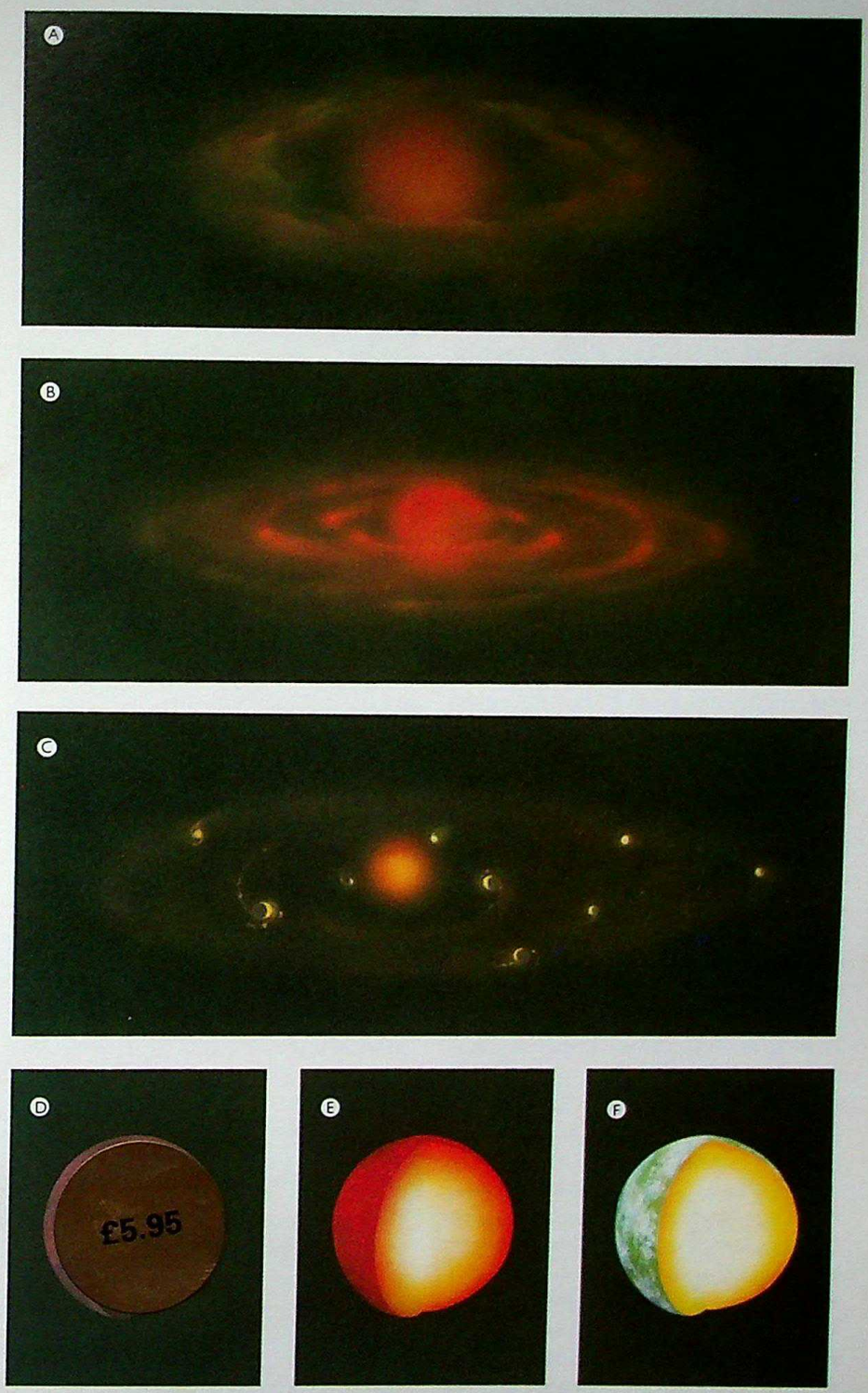
They think that the Earth was born about 4,600 million years ago. They found this out by studying rocks containing *radioactive* elements. These elements give out radiation, and over the years change into different elements. By measuring the relative amounts of these elements, scientists can tell how long they have been changing. And presumably they began to change when the Earth was formed.

One explanation of how the Earth was formed suggests that it came from material pulled out of the Sun. This is called the *tidal* theory. The suggestion is that at first the Sun existed by itself, without any planets around it. Then another star passed quite close to it, and set up great tides in the Sun. Some of the gas in the Sun's outer layers was torn away. This material in time massed together into the bodies we call the planets, which include the Earth.

Most scientists, however, prefer another explanation, called the *nebular* (cloud) hypothesis. According to this, the Sun and planets were formed at the same time. They were formed from a great cloud of dust and gas floating in space. Over millions of years this material began to collapse under the influence of *gravity*. (This is the force that makes every body attract every other body.) Eventually, the now much smaller mass of material began to rotate. And it formed into a disc with a bulge at the centre. Here and there in the disc little whirlpools, or eddies, of matter formed.

The bulge at the centre became smaller, and as it did so it became hotter. In time it became so hot that it was able to produce enough energy to shine. It became the Sun. The little eddies in the disc gradually gathered more material around them, and became the planets and their moons.

It is probable that most stars are born from a cloud of gas and dust in much the same way. So it is likely that many other solar systems exist in other parts of the universe. If this is the case, there could be many more planets, and in particular many more planets



The probable stages in the formation of the planets and the Earth. These bodies were formed from the cloud of dust and gas that whirled around the infant Sun (A). Gradually the dust and gas formed denser concentrations (B), which become embryo planets (C). Slicing through the Earth (D) we see a molten core. As it cooled, a crust formed (E), and then it became like it is today (F).

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like the Earth. This could therefore mean that other life forms exist on these planets. The trouble is that they are so far away from us that we shall probably never be able to communicate with them, even if we can speak the same language. And we can certainly never visit them.

Infant Earth

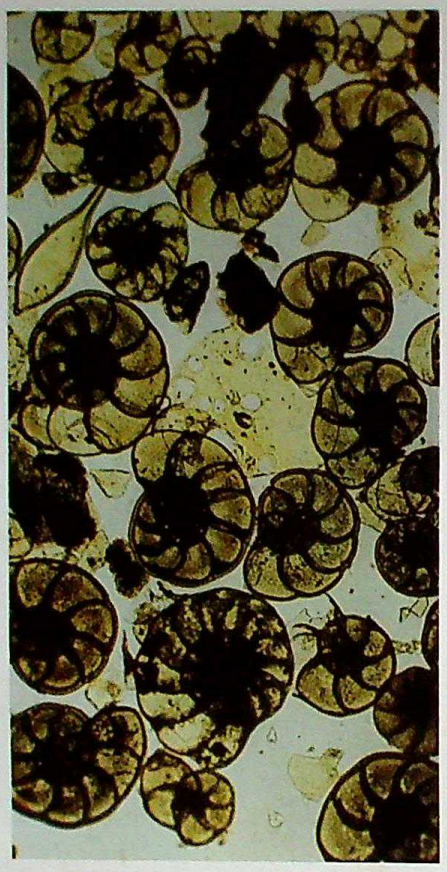
When the Earth was newly formed, it was very different from what it is today. It probably had a surface of molten rock. And it was surrounded by a steamy atmosphere containing poisonous gases like ammonia and methane. As time went by, the surface began to cool. Gradually a crust began to form over it. But the crust hardened and cracked. And time and time again molten rock flowed through the cracks onto the surface.

Gradually the crust got harder and harder. But violent upheaval was still taking place underneath. The crust was thrown up into jagged mountain ranges; it was racked by violent earthquakes, while volcanoes erupted and threw out molten lava. By now most of the water vapour in the atmosphere had condensed into rain and fallen to form great warm oceans.

Still the Earth's surface heaved and groaned. The land masses were constantly changing their shape and character. They were in turn covered and uncovered as the seas swept back and forth. The action of the seas and the weather gradually wore down the original rocks. Water carried the broken pieces away and deposited them as layers of sediment. These layers in time changed into other rocks, which were themselves later battered to pieces by water and the weather.

The Beginning of Life

Life began on Earth very early in its history. It began in the warm seas which then covered the planet. At first it was very simple plant life, like algae or slime. Then higher plants and simple animals developed. They were followed in turn by plants and animals with more complicated bodies. As time went by and natural conditions changed, some life forms died out. Others thrived because they were better suited to the new conditions. This idea forms the basis of the well-known theory of *evolution*.



The great limestone and chalk deposits of our world are made up largely of fossil shells like this. They are the chalky remains of tiny organisms called foraminifera which live on the ocean floor.

We know that life did begin and gradually evolve. But we are not certain how it began. Many people once thought that life came to the Earth from outer space in the form of 'spores'. These spores found conditions on Earth just right, and thrived. However, few people today think that this could have happened.

Most scientists now favour the idea that life just happened, when chemical and physical conditions were suitable. They believe that substances necessary for life were made in the Earth's early poisonous atmosphere. The substances then fell into the sea, where primitive life eventually began. Some scientists have carried out experiments to prove their point. They made up a mixture of gases similar to that probably present in the early atmosphere. It included ammonia, methane, nitrogen and hydrogen. Then they shone strong light on the mixture and passed electricity through it. This was to imitate what probably happened in the early atmosphere. After several days of this treatment, the scientists found that quite complicated organic substances had been formed. Some of these substances could build up into proteins, of which all living things are made.

Fossils

Scientists believe that there has been life on Earth for something like 3,000 million years. Between then and now a great variety of different plants and animals have developed, lived, and died on Earth. At first the only life was in the sea. Then plants became established on land. They were followed later by animals which could breathe out of the water as well as in it. They were *amphibians*, like the modern toad and frog are. Later still came the reptiles, which breathed only air. They included the gigantic and terrifying dinosaurs. Following the dinosaurs came the warm-blooded mammals. We humans are mammals. And so are our most familiar animals, such as dogs, cats, horses, cows, elephants and whales. Mammals are the most highly developed and most intelligent life form that has ever lived on Earth.

How do we know all this? How do we know that the species of plants and animals living today were not living millions of years ago? The answer lies in the rocks beneath our feet. In these rocks we find the remains of plants and animals that once lived on Earth. These remains are called *fossils*.

Most fossils are found in layered, or sedimentary rocks. In most rocks we can assume that the bottom layers were laid down first and are therefore the oldest. So if we find a fossil in one layer, we know that it is younger than a fossil in the layer beneath and older than a fossil in the layer

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above. By studying the fossils in the various layers, scientists are able to build up a picture of how life forms have changed and multiplied throughout the Earth's long history. Scientists who study fossils and the Earth's early history are called *palaeontologists.*

Many different kinds of fossils are found. In rare cases animals and plants are found with their whole bodies intact. For example, whole mammoths have been discovered perfectly preserved in ice in Siberia, Russia. They were ancestors of the elephant, and lived hundreds of thousands of years ago. Usually, however, the fleshy parts of plants and animals quickly rot. There remain only hard parts, such as shells, bones and teeth. Over millions of years even these parts often disappear. Sometimes the plants and animals left impressions of their bodies or bones in mud or clay, which gradually hardened into rock. Palaeontologists can find out something about them by taking plaster casts of the impressions.

Sometimes water containing minerals helps to preserve plant and animal remains. The minerals get deposited within the bones or plant tissues and harden them. Sometimes the minerals are deposited, while the bones or plant tissues are washed away. The remains turn into rock. We call such fossils *petrified* fossils. In some places whole tree trunks have been preserved in this way. Where they are found together, it is called a *petrified forest.* A famous one in Arizona, USA, contains hundreds of petrified trees that lived 160 million years ago. There is a petrified forest in Victoria Park in Glasgow, Scotland.

Many of the huge forests that once covered the Earth are preserved in a different form – as *coal.* Often you can see in coal the impressions of the fern-like leaves of the trees. Because of its origin, we call coal a *fossil fuel.* Oil and natural gas are fossil fuels, too. They are the remains of simple animals and plants that lived in ancient seas.

Evolution

Today we are all used to the idea of evolution. We know that the types of living things gradually change over very long periods of time and that one kind of long-vanished animal can often be thought of as the ancestor of several kinds now living. But 150 years ago, even the cleverest scientists found this very difficult to understand. They saw that the forms of fossils had changed with the passing of the ages. But they could not understand how this could have come about, because the kinds of animals and plants that they could see around them never seemed to change.

It was Charles Darwin, a naturalist who had sailed around the world for five years on the survey ship HMS *Beagle*, who first worked out a theory to account for the evolution of living things. Although the forms of wild animals and plants never seemed to change, Darwin remembered that human breeders were able to produce varieties of animal which were quite different from each other. Think how many different breeds of dogs there are! But breeders did not cause the differences to occur between different animals of the same type; they only *selected* for breeding those animals in which desirable features arose naturally. This is known as artificial selection. Darwin realized that diversity would become established in the forms of wild animals and plants if there were some kind of *natural selection* at work.

Darwin realized that in an unchanging environment, those animals of a particular kind which differed slightly from their fellows would tend to breed less prolifically than the others. Their novel features would thus not be preserved, and the form of the species would remain unchanged. But if the environment began to change – say, the climate became colder, a particular source of food disappeared, or a new disease became rife – then those animals with peculiarities which made them better fitted to survive under the new conditions would tend to outbreed the others. Over the course of time there would be a gradual change in the form of the total population, and the descendants of a single kind of animal in different areas which had suffered different changes in their environment might become quite different.

A fossil of an ammonite, a mollusc with a coiled shell that lived in great profusion between 350 million and 70 million years ago. Ammonite fossils are very common in sedimentary rocks. Specimens have been found up to 3 metres across.

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RECORD OF THE ROCKS

Over the years geologists have built up quite a clear picture of the Earth's history. They have done this by studying the layers of rocks that form the Earth's crust and the fossils of plants and animals within them. Where the rocks have lain undisturbed, the older rocks lie at the bottom and the younger at the top. Now different fossils are found in different layers. In the older layers the fossils will be of simpler, more primitive life forms. In the younger layers, the fossils will be of more advanced life forms. In other words we can guess the age of a rock by studying the fossils it contains.

This idea forms the basis of the *geological time scale*. On this scale geologists divide the Earth's history into a number of broad divisions called *eras*. They then subdivide the eras into shorter *periods*. Sometimes they go even further and divide the periods into shorter *epochs* and *ages*. Evidence of the fossils provides only the relative ages of rock formations. Scientists can, however, work out the actual age in various ways. One method is by measuring the relative amounts of certain elements in radioactive rocks. The illustration on the next page shows the main eras and periods, how long they lasted, and how long ago they occurred.

The first period in which life became abundant is the *Cambrian*. This began about 600 million years ago. There is little trace of life in earlier, *Precambrian* rocks. Only a few remains of simple algae and bacteria have been found. The oldest are the so-called Fig Tree fossils from South Africa, which seem to be more than 3,000 million years old. They are so small that you need a microscope to see them. Most traces of life in Precambrian times were destroyed.

The Cambrian is the first period of the *Palaeozoic Era*. This means the era of *Ancient Life*. Following this era is the *Mesozoic*, the era of *Middle Life*; and finally the *Cenozoic*, the era of *Modern Life*.

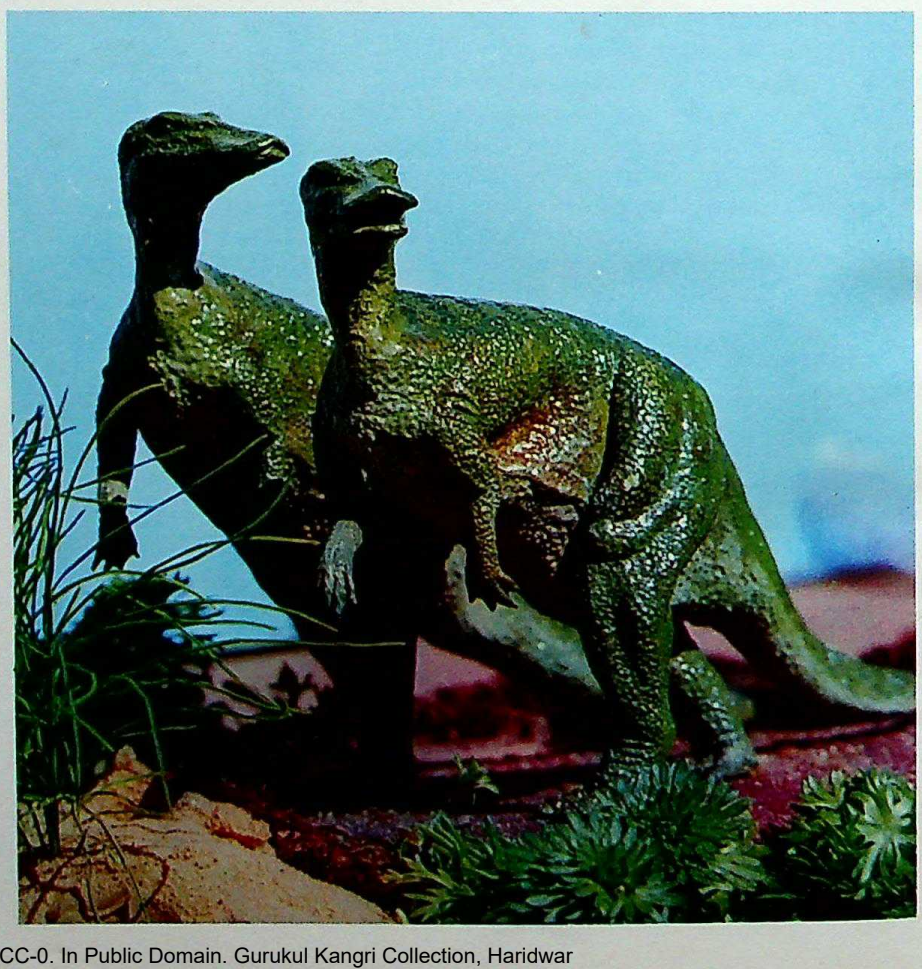
Ancient Life

During the Cambrian Period the warm, shallow seas teemed with simple life. There were algae, seaweed, sponges, and plant-like animals called sea-lilies, or crinoids. Simple animals with shells abounded. They included tiny creatures, whose shells in time built up to form great beds of chalk and limestone. Trilobites were common. They were hard-shelled creatures which looked something like wood lice. There were also many jelly-fish and starfish. Throughout the next two periods, the hard-shelled animals thrived. By the Silurian Period shellfish with double shells, called brachiopods, were among the commonest life forms. Their shells look like the oil lamps the Greeks and Romans once used, so they are often called lamp-shells. During this Period the first fern-like plants became established on dry land. Meanwhile, giant sea scorpions up to $2\frac{1}{2}$ metres (8 feet) long appeared in the seas. So did primitive fish.

But it was in the next, Devonian Period that fish became common. At first came shark-like fish with soft bones. Then true bony fish developed. Later some fish developed muscular fins and crude lungs. They were able to crawl about in the mud and breathe air. Some of these evolved into amphibians, which were equally at home on the land as in the water. Many insects and spiders were to be found among the developing land plants.

In the next, Carboniferous Period vast forests grew up in steamy swamps, as the seas swept back and forth over the land. The forests were of gigantic ferns and horsetails. It is the remains of these tree-like plants that form many of our coal seams. Amphi-

Duck-billed dinosaurs like these roamed over much of the Earth about 100 million years ago. They grew about 12 metres long, and were vegetarians.



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bians became the most important form of animal life. Some began laying eggs with shells, and gradually developed into reptiles.

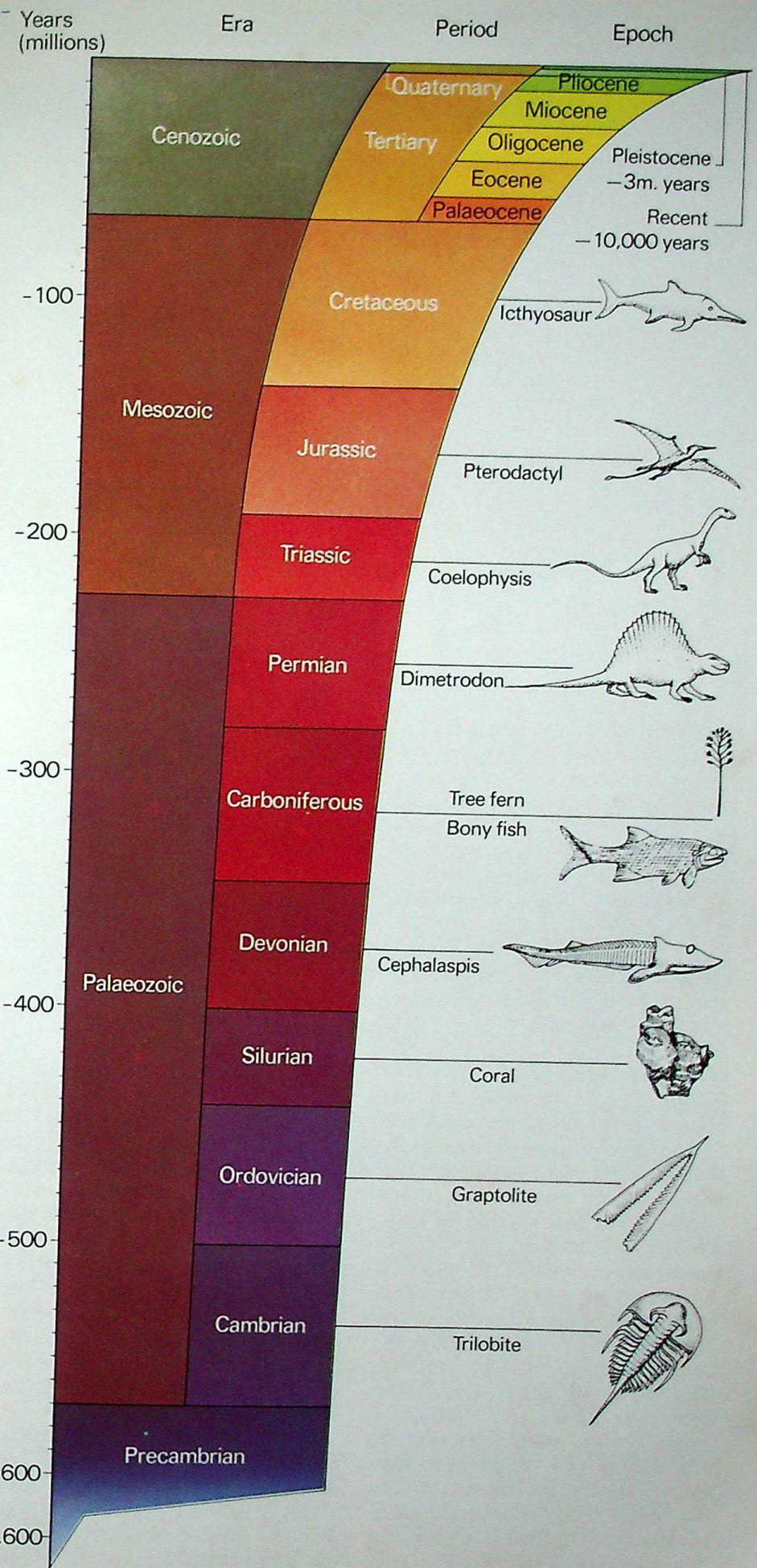
During much of the Permian Period great deserts existed, and reptiles became the main life form. With their thick, scaly skin, they were able to resist the heat better than amphibians could. One reptile, called *Dimetrodon*, had a large sail-like fin on its back to help conduct heat from its body. It was a distant ancestor of the mammals.

Middle Life

The first Period of the era of Middle Life, the Jurassic, saw the rise of the monster reptiles called dinosaurs. The word means 'giant-lizard', and gigantic they were. *Brontosaurus* ('thunder-lizard') was often more than 20 metres (65 feet) long. It usually remained in the water, which helped to support its huge body. It and the scaly, armour-plated *Stegosaurus* were harmless plant-eaters which had tiny brains. Also during this Period the winged ancestor of the birds appeared. It was named Archaeopteryx.

The Cretaceous Period is so called because many of our chalk beds were laid down during this time. The flying reptiles, or pterodactyls, appeared. They had long, toothed beaks and large, leathery wings. The most terrible dinosaur of all thrived, called *Tyrannosaurus* ('tyrant-lizard'). It was a meat-eater which stood upright on its hind legs. In the plant world flowering plants developed and became common.

At the end of the Period the dinosaurs suddenly died out. But no-one knows why. Possibly it was because of the general rise in land levels that took place then. This would have reduced the extent of the lowland swampy



This diagram shows both the geological time scale and the fossil record. On the left can be seen the approximate number of years, in millions, into which the Earth's history is usually divided. The eras and periods are followed by representative animals and plants, which lived at the time.

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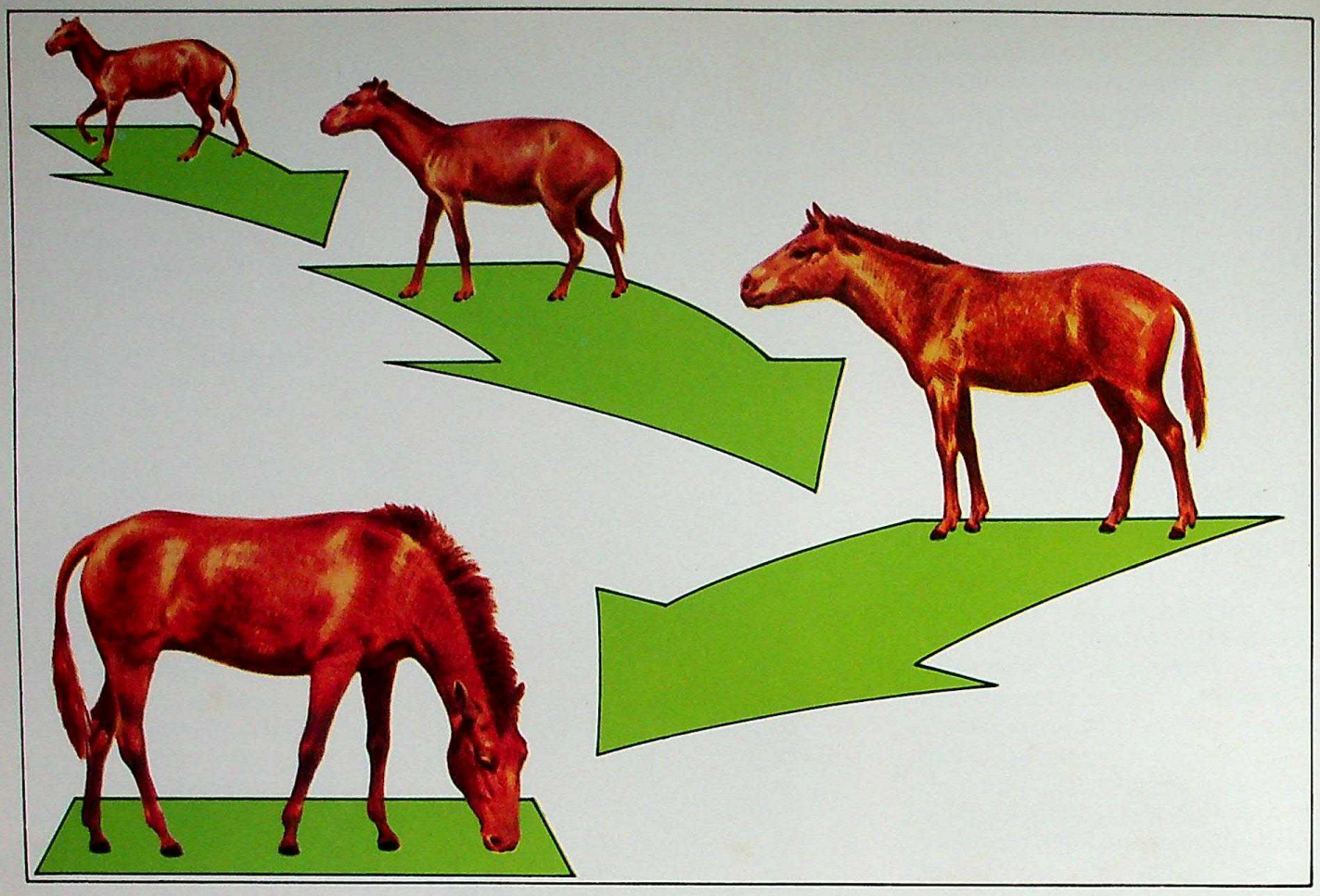

Eohippus (top left), although the true ancestor of the horse, was for a long time not recognized as a horse at all. Mesohippus, of the Oligocene period, was a three-toed browser, and the Miocene Merychippus, although also three-toed, was a grazer with longer grinding teeth. Pliohippus (below left) was the first to have a single toe.

areas which the larger dinosaurs depended on. It would also have affected the climate and the plant life on which the dinosaurs fed. Alternatively, they may have been killed by disease. Or perhaps the rapidly increasing number of mammals caused them to die out by eating their eggs.

Recent Life

In the Tertiary Period we can trace the development of the mammals into the dominant life form. In geological terms their rise was very rapid indeed. At the beginning of the Period there were only a few species of tiny, shrew-like mammals. By the end there were several thousands. Ancestors of many of our most familiar animals appeared in the Eocene ('dawn of life') Epoch. They included *Eohippus*, which was the small, fox-like ancestor of the modern horse. Primitive rhinoceroses, elephants, cattle and sheep also appeared. And two groups of mammals took to the seas. They were primitive whales and fin-footed creatures like dugongs ('sea cows').

The following epochs were notable for the development of the *Primates* – the monkeys and apes. The first apes appeared about 25 million years ago. Some of the apes in time developed certain man-like features. But it was not until about 3 million years ago that early Man appeared, distinguished from the apes by his larger brain.

During most of the Tertiary Period the climate in general remained fairly mild. Only in the Pliocene Epoch did the climate become cooler. From the Miocene Epoch on, great volcanic eruptions occurred in many parts of the Earth. During the Tertiary Period, too, all the major mountain chains were formed, the Alps, the Himalayas, the Sierra Nevada, and the Rocky Mountains. The Alps received a final uplift at the end of the Period and in the Quaternary Period.

The most recent, Quaternary Period is marked by great Ice Ages. The climate grew cold, and about 1 million years ago great glaciers formed in northern Europe and North America. In North America they covered Canada and extended as far south as Long Island and the Missouri and Ohio River valleys. In Europe they covered Scandinavia and much of Great Britain. Several times the glaciers advanced and retreated. The most recent Ice Age ended only about 11,000 years ago. During the Ice Ages many species of large mammals roamed the Earth. They included mammoths, mastodons, woolly rhinoceroses, giant ground sloths and sabre-toothed tigers. The astonishing thing is that these species suddenly died out. No-one really knows why. Their sudden death may have been caused by rapid changes in climate. It may have been caused somehow by Man.

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MAN BECOMES CIVILIZED

A detail from one of the paintings in the Lascaux caves, executed some 20,000 years ago.

The Lascaux Caves in southern France show that Man was a fine artist at least 20,000 years ago. His paintings depicted mainly hunting scenes, for hunting was his main way of life. It gave him meat to eat and skins for clothing. He also gathered berries and fruits and dug roots for food. He lived in caves or in primitive shelters.

Since early man could not write, there is no written record of his activities. He therefore is called *prehistoric* man. The age in which he lived is called the *Stone Age* because he used mainly stone tools. The Stone Age lasted to about 3500 BC in some parts of the world, but much later in others. The end of the Stone Age was marked by the time when Man began to use bronze instead of stone for his tools. Then a *Bronze Age* began.

The last period of the Stone Age, the so-called *New Stone Age* or *Neolithic period* began about 6000 BC. It was a time in which Man made striking advances. In particular he learned how to grow crops and domesticate animals. He became less reliant on hunting for survival. No longer did he have to move around so much after the game. He could settle down and build permanent shelters. Villages grew up as people congregated together, and group activities became more a way of life.

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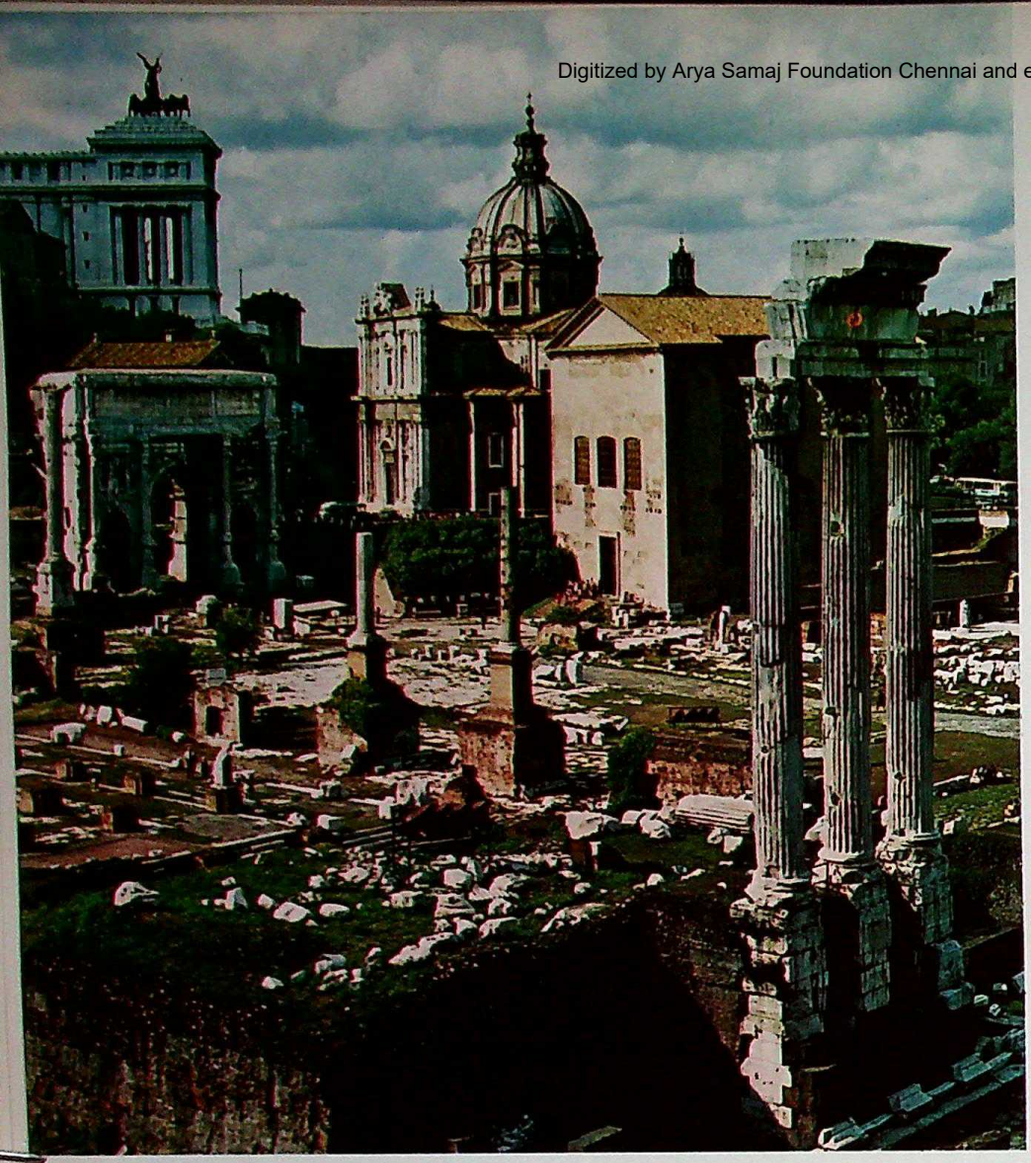

The ruins of the Forum in Rome, where the orators used to deliver their speeches.

Early Civilizations

The coming of the Bronze Age in about 3500 BC coincided roughly with the beginning of recorded history. By this time there were not only villages, but large cities in the fertile Nile Valley in Egypt and in Mesopotamia. Mesopotamia (meaning 'between the rivers') was a once-fertile region between the Tigris and Euphrates rivers (now in Iraq). It was the home of the Sumerians and later the Babylonians. The ancient Egyptians developed a kind of picture-writing called *hieroglyphics*. The Sumerians developed *cuneiform*, or wedge-shaped writing.

Both civilizations boasted great palaces and monuments. The pyramids of Egypt stand as a vivid reminder of the skill of the ancient Egyptian architects. It is interesting to note that the Great Pyramid of Egypt, built in about 2500 BC, remained the biggest construction for some four and a half thousand years. It was surpassed only in 1941 by the Grand Coulee concrete dam in the United States. Both the Egyptian and the Mesopotamian civilizations developed advanced societies, with a well-defined social order, central and provincial government, and law.

Other civilizations developed in other parts of the world. One grew up in about 2700 BC in the Indus Valley in what is now Pakistan. Somewhat later (about 1500 BC) arose the great Chinese civilization in the Hwang valley. This civilization has continued until the present day.

In the Mediterranean region came a succession of advanced cultures beginning with the Cretan in the 2000s BC. Then came the Greek, and finally the Roman. The Romans built up a great Empire which eventually covered most of western Europe, southwest Asia and northern Africa. The ancient Romans were skilled in the arts, in literature, painting, sculpture and architecture. They were brilliant engineers, whose roads and bridges were not bettered until the 1800s. Their government was complex and sowed the seeds of the modern parliamentary system. A host of civil servants attended to day-to-day affairs. Roman law still provides the basis of law in many countries of the world today.

The Roman Empire reached its peak in the 200 years following the establishment of Augustus as Emperor in 27 BC. It finally collapsed in the AD 400s. The eastern part of the Empire, however, centred on Byzantium, continued for a thousand years longer. Byzantium came to be called Constantinople. The Byzantine Empire came to an end when the Turks captured Constantinople in 1453. They renamed the city Istanbul. The Byzantine Empire is important historically not only for the exquisite art and architecture it has left us. It is also important because it provides a connecting link between the culture of the early civilizations and our civilization today.

Birth of the Modern World

The 1400s marked the end of a period of history often called the *Middle Ages*, which began with the break up of the Roman Empire in the AD 400s. There were three main classes of people in the Middle Ages: the lords, with their entourage of knights; the clergy; and the peasants, or *serfs*, who worked on the land. The pattern of life that developed is called *feudal*.

As the Middle Ages progressed, towns began to grow, and the feudal way of life began to change. Merchants began to become more important, as did craftsmen and artists. Trade expanded as the Crusades and wars brought contact with people in other lands. People's horizons began to widen, and there came a rebirth in learning. This period of history, the *Renaissance* (rebirth), was marked by a flowering of the arts. Painters such as

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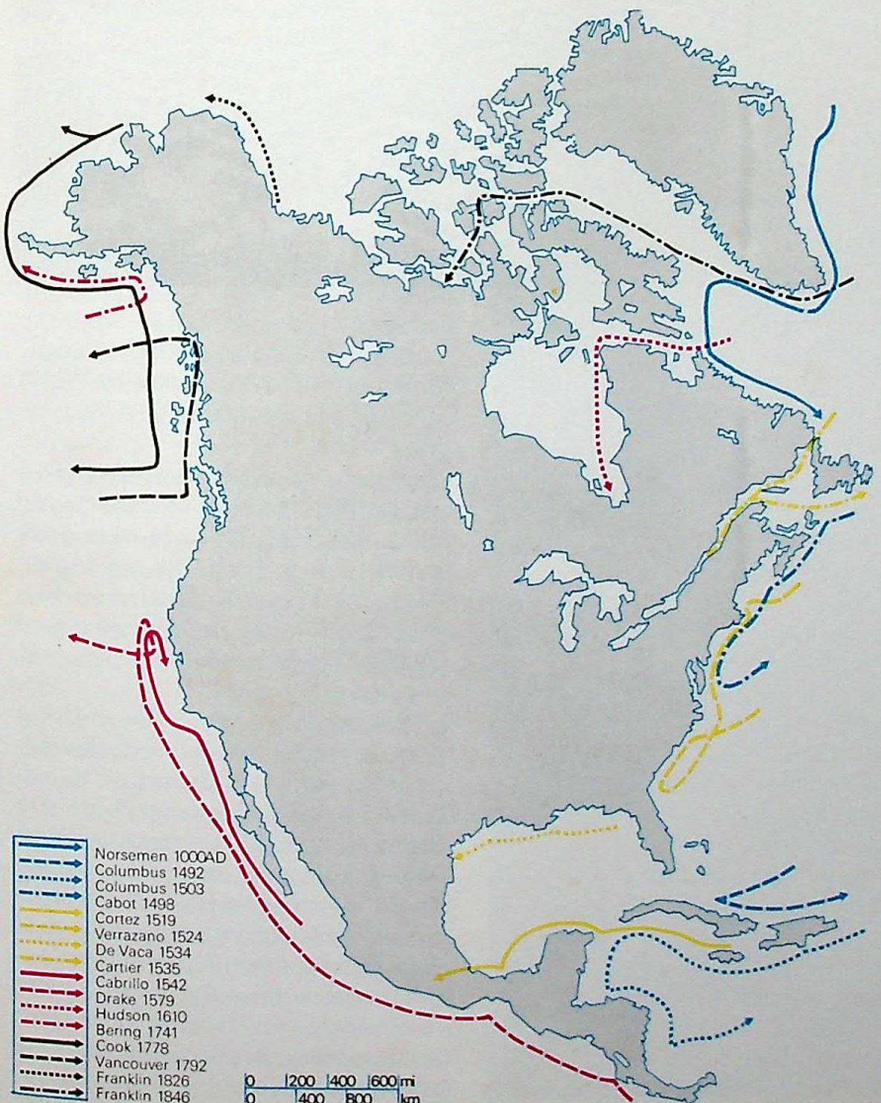
Leonardo da Vinci and Michelangelo; sculptors such as Donatello; and architects such as Brunelleschi produced works of genius. Scholars such as Erasmus challenged traditional ideas. People like Martin Luther began to challenge the teachings of the Church, and set in motion the so-called *Reformation*.

At the same time, bold adventurers began sailing east and west in search of new lands. They sailed in search of a sea route to the Indies, famed for their spices and treasures. The Portuguese and Spaniards were to the fore in this age of exploration. In 1492 Christopher Columbus sailed west and eventually struck land in what he thought was India. The islands he found have since been called the West Indies. They were not part of Asia, as he originally thought, but part of a new continent. An Italian, Amerigo Vespucci, first realized this, and gave his name to the continent – *America*.

The Spanish and Portuguese began to explore inland in central and south America. They subdued the native 'Indians' there, and established settlements. The British and French later began to settle in North America. The first English settlement was established in Jamestown, Virginia (1607), but hardly managed to survive. A band of Puritans from the *Mayflower* established a more successful colony at Plymouth, Massachusetts, in 1620. They became known as the *Pilgrim Fathers*. The southern settlements in Virginia and elsewhere did not begin to thrive until after the development of cotton plantations, and the import of African slaves.

In the late 1700s Captain Cook sailed to Australia and New Zealand, and colonies were soon established there. Africa remained relatively unexplored until missionaries such as David Livingstone and adventurers such as Richard Burton forced their way into the interior.

This map shows the routes of the main voyages of discovery undertaken by the early explorers of North America.



The Rise of Industry

In the 1700s a series of inventions in Britain to do with textile-making led to the growth of a textile industry. Cloth was no longer made at home by one or two people using a spinning wheel and a hand loom. It was made in factories on large power machines operated by a work force employed by the factory owner. The first factory machines were driven by water power. But soon steam engines were being used. They were made into a relatively efficient means of power by James Watt.

The iron industry began to develop quickly as well after Abraham Darby found that iron ore could be smelted better with coke. The demand for coke prompted an increase in coal mining. The basis for industrial growth was established. Canals were cut through the countryside to transport raw materials and finished goods between the mines, factories, towns and seaports. The early 1800s saw the growth of the railways into the major means of transport.

This *Industrial Revolution* spread from Britain to other parts of the world. It changed the pattern of life of many people. People drifted from the countryside into the towns to work in the factories. They worked long hours for next to nothing, and lived in tiny houses crowded together around the factories. To improve their lot, the workers gradually formed trade unions, which fought for and eventually won better conditions and pay. The movement of people into the towns, or *urbanization*, is still going on today in many countries. It is occurring most rapidly in the developing countries.

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THE CITY

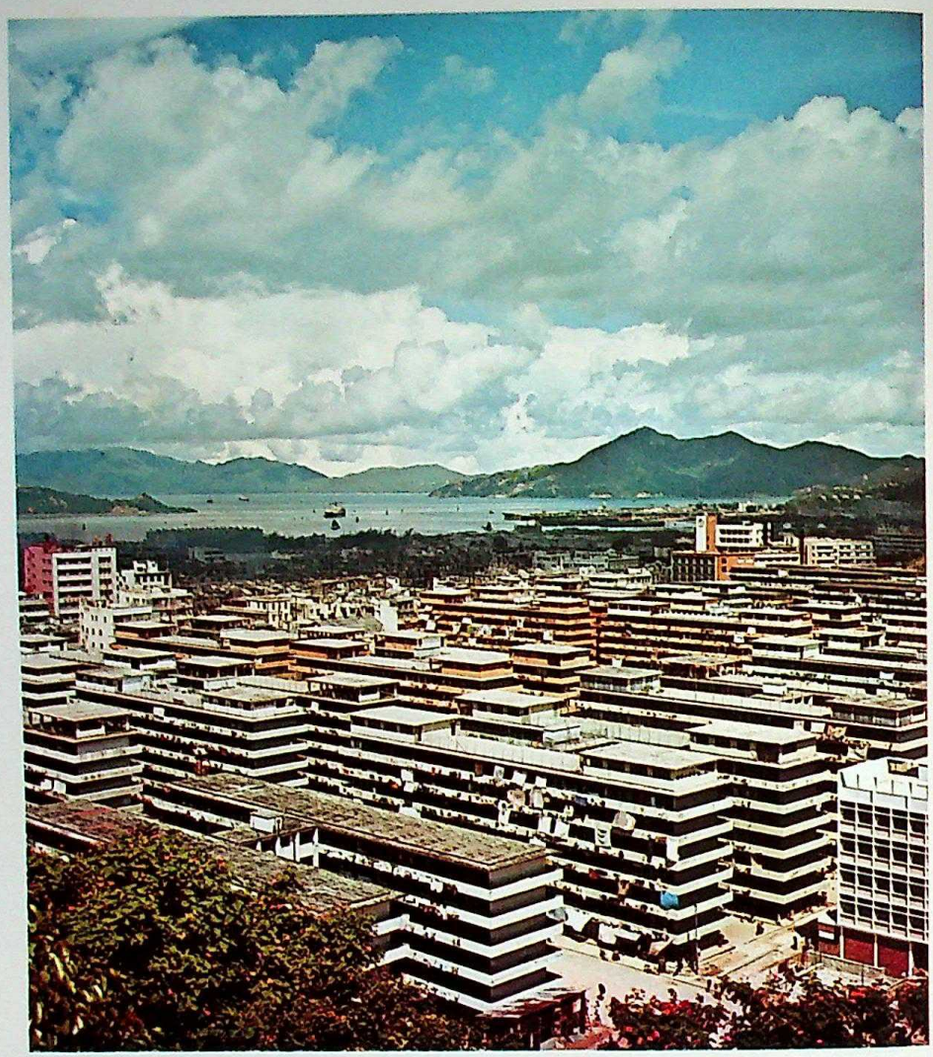
Most cities grew up for very definite reasons. Some of the oldest cities were built around fortresses, which commanded a strategic position. Verdun, located in a gap in the hills, grew up as a fortress town. So did Peking. Some cities grew up around a cathedral (for example, Canterbury) or religious shrines or centres (Lourdes, Mecca, Jerusalem). Some cities became centres of learning, like the university towns of Oxford, Cambridge and Heidelberg.

Other cities owe their origins to trade, mining and industry. Some great trading cities have developed into major commercial centres – Zurich and Frankfurt are particularly well known in the field of finance and banking. Salzburg became important because of the salt mined there; Johannesburg because of its gold mining. Industrial towns like Pittsburgh and Bethlehem (in Pennsylvania) thrive because of their steel and heavy industries.

For various reasons some cities have become primarily administrative centres. Geneva, for example, is the home of many international organizations, such as UNESCO and CERN. Other cities have been built specifically as centres of government – Brasília and Canberra are good examples.

Although many cities can be labelled in the manner we have just described, a great many more have multiple functions. This is especially true of the largest cities, such as New York and London. They are at once centres of commerce, administration, industry, communications, culture and tourism.

All cities suffer to a greater or lesser degree from similar problems. There is overcrowding, with its consequent demands on housing, education, health, recreation and other facilities. In developing countries such as Brazil and India, cities just cannot cope with the invasion of people from the countryside. In cities such as Rio de Janeiro and Calcutta, for example, makeshift and disease-prone shanty towns have grown up on the outskirts. Other hazards of urban life include traffic congestion and noise and air pollution. Cities usually have a high crime rate too.



Apartment blocks spread right across the city of Kowloon, Hong Kong. Intensive housing like this is needed to cope with the vast population.

Despite these disadvantages cities invariably provide better facilities and services than rural areas. And organizing and administering these services is much more efficient in the urban environment, with its closely knit population.

In cities with a large immigrant population, people of the same race tend to congregate together in the same area. This is clearly seen in New York City, for example. Most of the Negro population live in Harlem; a great many Latin Americans live there too. The Chinese are concentrated in Chinatown.

In many developed countries over recent years there has been a gradual drift of people away from the cities. People who work in the cities commute, or travel daily, to them. However, this trend could well soon be reversed as the cost of travelling becomes increasingly high.

But the overall trend in the long term must be towards city living, as the world population continues to grow. Already there are more than 1,200 cities with a population over one million. With their suburbs, cities like Tokyo and London have a population of more than 10 million. Some experts have forecast that in the not too distant future, strings of such mammoth conurbations will girdle the globe.

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The time when Man became a farmer was a turning point in the development of civilization. Even today practically half of the world's population are farmers, who work on the land growing crops and raising animals. The proportion of people in a country who are farmers, however, varies widely. In India and China about 8 people out of 10 are farmers. But in the United States only about 1 person in 10 is a farmer. Only about a third of the world's land surface is suitable for farming at present. About a third is forested. Most of the rest is unsuitable for cultivation of any kind. It consists of mountains, deserts, frozen tundra and other waste land.

Most people work on the land in underdeveloped countries. They often use methods that have changed little over the years. In many parts of Africa, South America and Asia farmers grow only enough food to support themselves and their families. This is often called *subsistence farming*. These farmers do most of the farm work by hand and by using animals to draw carts and simple implements, such as wooden ploughs. Some farmers practise what is called *shifting cultivation*. They clear a patch of land of trees and shrubs and grow crops on it. After a few years the crops begin to fail because there is no nourishment left in the soil. Then the farmers move on. In some areas this kind of practice has led to severe soil erosion. In others it has placed species of wildlife in danger by destroying their habitat.

There are fewer farmers in highly developed countries, but their farms are very productive. This is because they make use of machines on a large scale. They take advantage of scientific advances in plant and animal breeding and raising. They use chemicals to improve the yield of their crops and to prevent pests and diseases. Many raise animals on a very large scale in controlled conditions. Pigs, chickens and calves are often raised by such *intensive methods*.

In general two main kinds of farming are practised. One is arable, or crop farming. The other is livestock, or animal farming. Most farmers grow several kinds of crops and often raise some livestock as well. This kind of *mixed farming* is usually less risky than relying on a single crop for their income.

Arable Farming

Practically all farmers grow crops of one kind or another. Many farmers grow crops so that they can sell them. These are known as *cash crops*. Maize and potatoes are important cash crops. Other farmers specialize in raising livestock. And they grow crops to feed their animals. Such crops are called *forage crops*.

Grass is the most important crop grown for feeding livestock. Clover, rape, kale and lucerne (or alfalfa) are other widely grown forage crops. These crops are grown not only for grazing, but also for making into hay and silage. *Hay* is the cut, dried crop. *Silage* is the green crop which has been preserved by a kind of pickling process in an airtight tower, or *silo*.

Whatever kind of crop he grows, the farmer carries out much the same kinds of operations. First he prepares the land to receive the seed. He usually does this by ploughing and harrowing. Ploughing breaks up the hard ground from a previous crop and turns it over. Harrowing makes the soil surface level and fine. Then the seeds are sown in the prepared soil. When the crops are mature, they are harvested.

In most countries now machines are used on a large scale. The tractor is the most useful workhorse. It is used to pull trailers

Ploughing is the essential first stage in the cultivation of the soil. It breaks up the ground and buries the weeds.

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and a variety of implements. They include ploughs, seed drills, cutters, balers and forage harvesters. The most important harvesting machine is the combine, which is used especially for cereal, or grain crops. It is so called because it *combines* the actions of cutting the crop and threshing it (removing the grain). Fleets of combines make it possible to harvest the great prairie wheatfields of the United States and Russia.

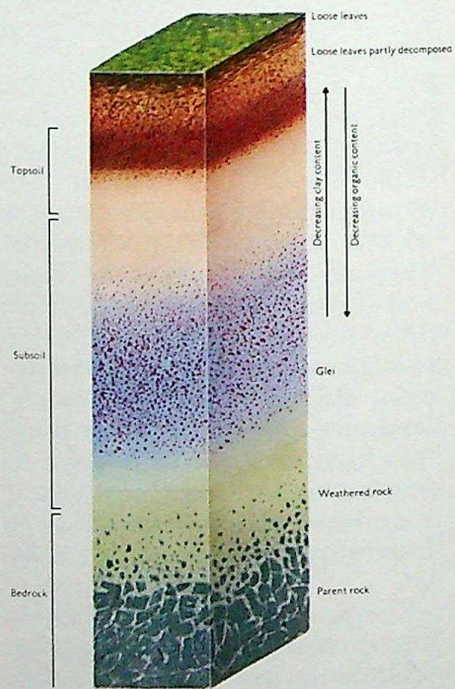
Growing crops take a great deal of nourishment from the soil. The farmer must therefore take measures to see that the soil remains fertile year after year. One way he can help do this is by *crop rotation*. This means growing a different crop in a field each year. Many farmers practise a four-crop rotation. For example, one year they may plant wheat, the next grass, then barley, and finally a root crop such as turnips. Crop rotation not only helps the soil to recover. It also helps control weed growth, and prevents the build-up of pests and diseases.

In addition to crop rotation, farmers now use *fertilizers* on a large scale to make the soil more fertile. They use materials rich in nitrogen, phosphorus, potassium and calcium. An excellent natural fertilizer is farmyard manure. This is a rotted mixture of animal wastes and straw. This manure improves the texture of the soil, too. Guano – bird or bat droppings – is another good manure. But there is not sufficient natural fertilizer to go round. Artificial, or chemical fertilizers must be used as well. One of the most widely used is superphosphate, which is the main product of the huge fertilizer industry. Nitrates are also used on a vast scale. In fact they are beginning to cause a serious pollution threat in rivers. Lime and limestone are useful as soil conditioners, for they prevent the soil becoming too acid. Plants do not grow well in acid soils.

Manufactured chemicals are now being used on a large scale to control weed growth and pests and diseases. The chemical weed-killers are known as *herbicides*. They are *selective*, which means they kill weeds without harming the crops. The insect-killers are called *insecticides*; and the fungus-killers, *fungicides*. Unfortunately, the widespread use of herbicides, insecticides and fungicides can cause great harm to the environment. It is a major pollution problem. These chemicals often get into the bodies of small creatures like mice, birds, and fish. The amount of the chemicals builds up in the bodies of higher creatures which live off the smaller ones. There are even small amounts of insecticides in our own body tissues.

Important Crops

The most important of all crops farmers grow are the *cereals*, or grains. Almost half of all agricultural land is used for growing cereal crops. The main creals are wheat, rice, maize, barley, rye and



Above: A section through a typical sample of soil. From an agricultural point of view it is the topsoil which is important. To be fertile it needs a high organic content.
Left: Fertile land is plentiful in the US state of Washington, where this wheat is being harvested.

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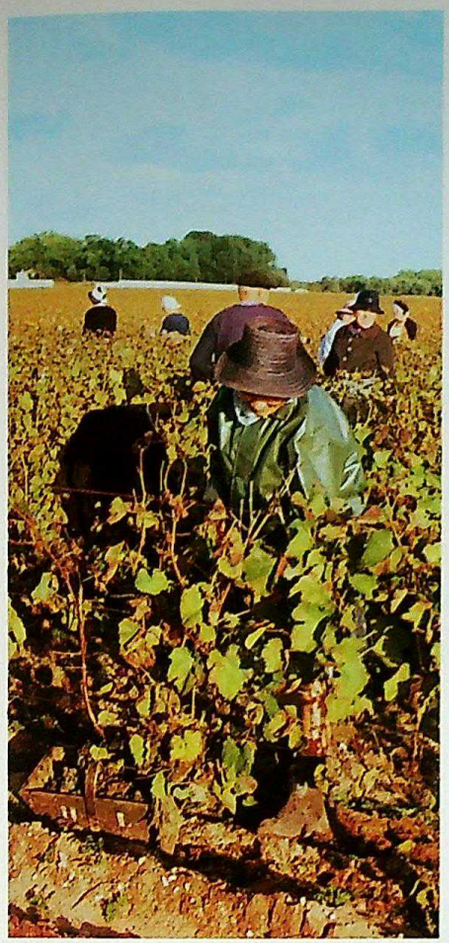

Left: Grape-picking in the Sauternes district near Bordeaux, France. This district is famous for its fine sweet wines.
Below: Sugar cane is grown on a vast scale here in Barbados, and elsewhere in the West Indies.

oats. Wheat is ground into flour to make white bread and cakes. Rye is made into coarse brown bread. Rice provides the basic diet of many Asian peoples. Barley is mainly used as a cattle feed and for making beer and whisky. Oats are made into oatmeal and are also used as a cattle feed. Maize, called corn, in the United States, is widely eaten as a vegetable (sweet corn), and is made into breakfast cereals (cornflakes). It is also made into oil (corn oil) and flour (cornflour).

Wheat, rye, oats and barley grow best in the cool climate of Canada, the United States, and northern Europe. Russia and the United States, are the biggest producers. Most maize is produced in the mid-western United States, but it is grown in many other regions of the world. The most rice is produced in India, Japan, and Pakistan. In many parts of south-east Asia, rice is grown in flooded land. Farmers divide their land into *paddies*, or areas surrounded by dykes to retain water. They release water through the dykes to keep the land flooded. They usually plant and harvest the crop by hand.

Another important group of crops are those that produce fibres for making textiles. They include cotton, flax, jute, and hemp. Cotton is the fleecy fibres surrounding the seed of the cotton plant. This short plant is cultivated on a large scale in hot climates. The southern United States produces most cotton, which is now harvested by machine. Cotton is also an important crop in India, Egypt, Brazil and Mexico. Flax is grown for its stalks, which contain long fibres which are made into *linen*. It grows in the cool climates of northern Europe; Russia, Poland, Belgium and France are the major producers. Jute is a tropical plant widely grown in India and other parts of southern Asia. Hemp originally came from Asia but is now grown in Europe and the United States.

Fruit is grown on a very large scale all over the world. In temperate climates apples, pears, plums, and soft fruits such as strawberries and raspberries are grown. In the sunny Mediterranean climates grapes, peaches and citrus fruits flourish – lemons, oranges and grapefruits. They are also cultivated in California and Florida in the United States and in South Africa. Figs, dates and olives are other important fruit crops around the Mediterranean. In tropical climates such fruits as bananas and mangoes are grown. Bananas are an important food crop in India, Africa, Central and South America, and the West Indies. There are huge commercial plantations in Brazil, Mexico, the West Indies and the Canary Islands.

Vegetables of many kinds are grown widely on farms as well as

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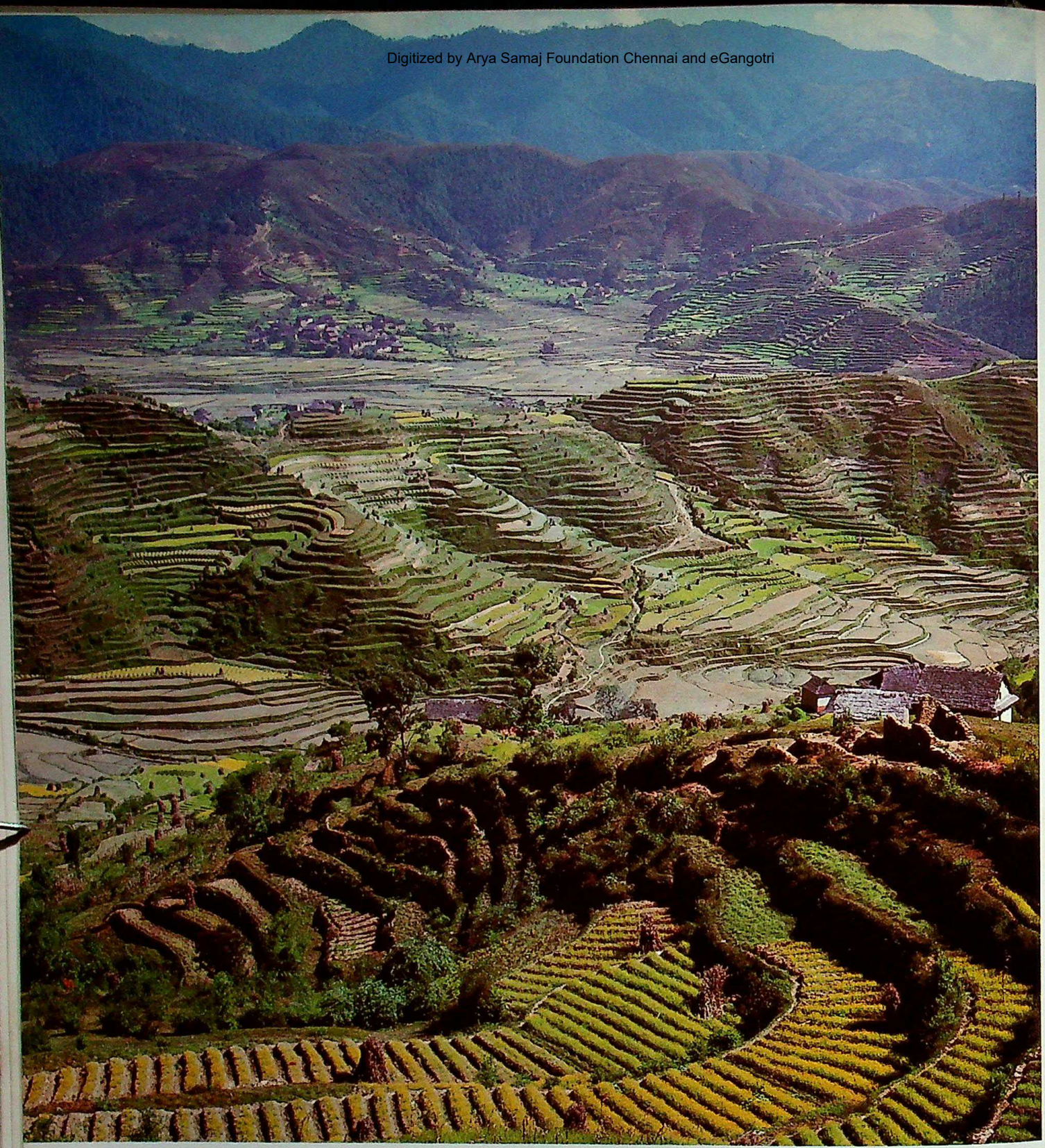

A fascinating man-made landscape in Nepal, where farmers have terraced the hillsides. This helps conserve water and prevent soil erosion.

in market gardens. In temperate regions potatoes are a very important crop, as are beans, peas, and cabbages. In warmer regions yams and sweet potatoes form an important part of the diet.

Sugar is an important crop too. Most of the world's sugar comes from sugar cane. Sugar cane is a very tall grassy plant rather like bamboo. A sugary sap is obtained by crushing the stems. Sugar cane grows in tropical and sub-tropical countries. Cuba is the world's largest producer. Brazil, Hawaii, Mexico and India also grow large quantities. The other major source of world sugar is sugar beet. Sugar beet is a root crop, which grows in the cool, temperate regions of Europe and the United States. Russia is the world's largest producer.

Among the many other important crops are oil crops, tobacco, rubber and the beverage crops – coffee, tea, and cocoa. Oil crops include coconuts, cotton seeds, groundnuts (peanuts), olives, soya beans and sunflower seeds. They are made into oils for use in paints, cooking oils, and margarines. Tobacco is grown on

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a large scale in the United States, India and China. Most rubber is produced on plantations in Malaysia and Indonesia. Like rubber, the beverage crops grow in tropical climates. Brazil grows most coffee, India and Sri Lanka (Ceylon) most tea, and Ghana and Brazil most cocoa.

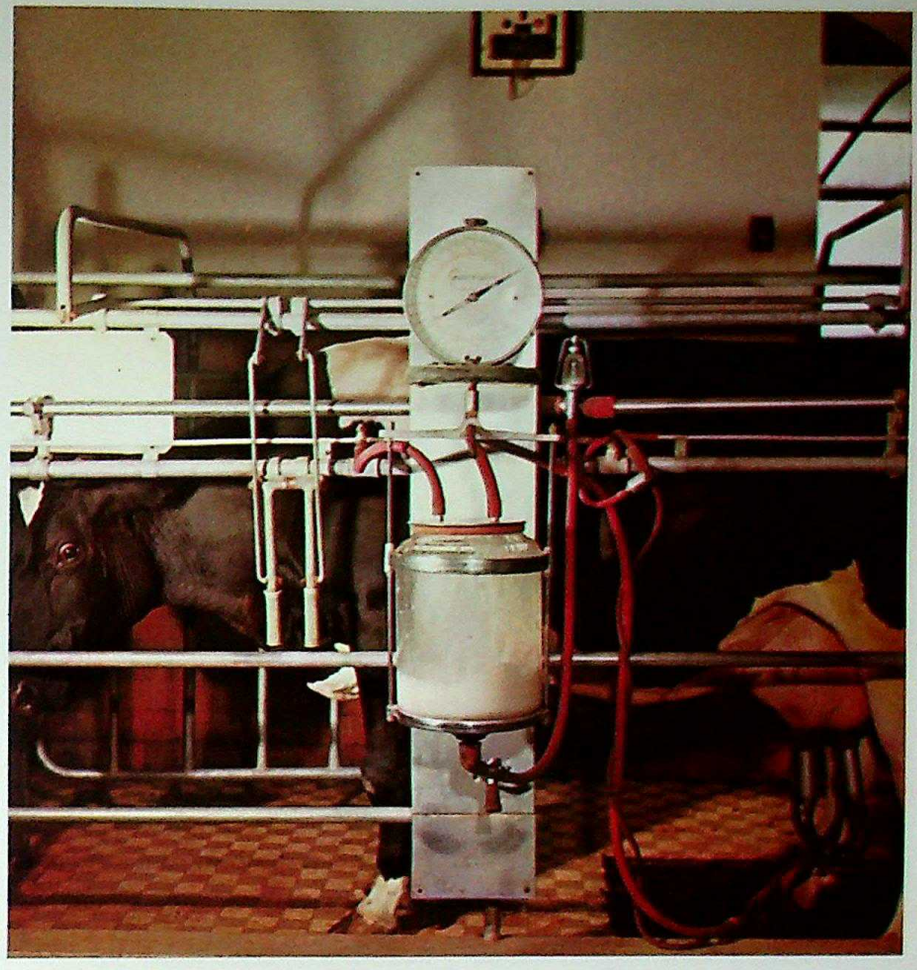
Livestock Farming

Cattle are the most important livestock raised on most farms. They provide meat to eat, and milk to drink and to make into butter and cheese. Their hides can be made into leather, and their bones and hoofs into fertilizer and glue. In some countries cattle are used as draught animals, to pull carts.

Beef cattle are raised for their meat. The Aberdeen-Angus, Hereford, Charolais and Shorthorn are among the most important beef breeds. The humped Brahman, or Zebu, cattle are a suitable breed for hot, humid climates like Africa and India. Many people in India, however, will not eat beef, because they think cattle are sacred. Beef cattle are raised on a vast scale on the pampas of Argentina and the prairies of the United States. Australia also has great cattle ranches.

Dairy cattle are raised for their milk. The black and white Friesian produces most milk, often more than 4,500 litres (1,000 gallons) a year. The Jersey and Guernsey produce the creamiest milk. Some of the most productive dairy herds are raised in north-west Europe and the north-east United States. In New Zealand dairy farming is one of the most important occupations.

Pigs are raised in largest numbers in China, Russia, the United States and Brazil. In the United States huge pig farms are located in the so-called Corn belt of the mid-west. This is the region that produces the most maize (corn), on which the pigs are fed. In Europe pigs are raised in smaller batches, and are fed mainly on barley. Pigs put on weight quickly and can be sold for slaughter at about 6 months old. Among the well-known breeds are the Yorkshire (large white), Hampshire (Wessex saddleback), Duroc and Landrace.



On modern dairy farms the cows are milked by machine, which is faster and cleaner than by hand.

Sheep are raised both for their meat and their fleece – wool. Lambs are sold for slaughter when they are about four months old. Australia has the largest number of sheep – over 180 million of them. Most of these sheep are of the Merino breed, which grows a fleece weighing 10 kilograms (22 pounds) or more. Altogether Australia produces more than 900 million kilograms (2,000 million pounds) of wool a year. In Australia sheep are kept in flocks of thousands on the open range. Large sheep ranches are also found in New Zealand, Argentina and the United States.

Unlike sheep, their close relatives, most *goats* are kept for their milk. And their hides make valuable leather. In many parts of Africa and Asia people keep large herds of goats in regions where cattle cannot survive. Goats are able to exist on dry, poor land where many other animals would starve. Goats are also raised for their milk in many parts of Europe particularly Norway, France and Switzerland. The Saanen and Nubian are good milk breeds. Some goats are bred for their hair. The Angora and Cashmere breeds of Asia grow fine, silky hair. The hair from the Angora goat is called *mohair*.

Poultry are the other main class of livestock. They are kept for their meat and their eggs. Chickens, ducks and turkeys are raised in most parts of the world. The United States and Britain raise most chickens. They do so by intensive methods. The chickens raised for meat, called *broilers*, are kept in very large numbers under cover. They are fed, watered and cleaned mechanically. One man can look after up to 50,000 broilers. Broilers reach market weight (about 2 kilograms, 4 pounds) after about 3 months. Egg-laying hens are raised in separate cages, stacked together in so-called *batteries*.

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FISHING THE SEAS

Fishing is one of Man's traditional occupations, which still provides him with one of his most valuable foods. Like meat, fish is rich in proteins and vitamins. In some regions of the world it provides people with their only source of protein. Often, however, the object of fishing is to catch fish which are then processed into fish oils and meals. Fish meals are used for feeding livestock and as a fertilizer. Fish pastes and glues are other products.

The importance of the fishing industry varies from country to country. In a country such as Iceland a large proportion of the population depends on fishing for a living. This living is threatened if their catches decline. In recent years Iceland has extended its fishing limits to prevent their traditional fishing grounds from being over-fished. This has led to international disputes, particularly with Britain. Over-fishing is becoming a serious problem in many parts of the world. Each year more than 55 million tonnes of fish are taken from the oceans. But marine scientists think that with careful management twice this amount can be removed. The main fishing grounds of the world are in the north-west Pacific and the north-east Atlantic.

Cutting up a whale carcass on a whaling ship. The blubber is boiled to give valuable oil.

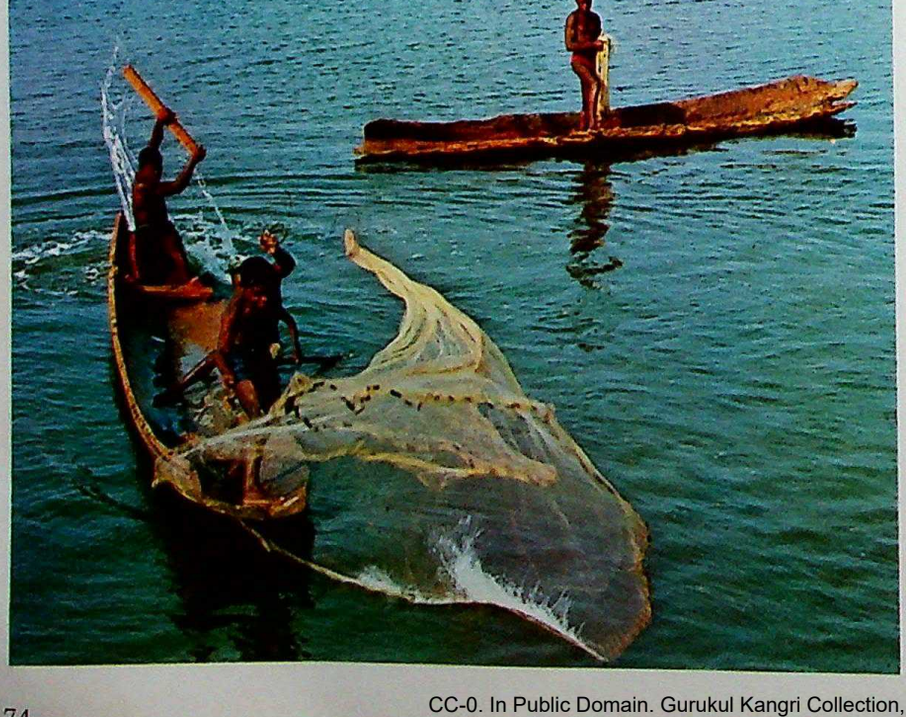
The leading fishing country is Peru. Peru concentrates on fishing for the anchovies which abound off its shores. The Japanese fishing industry is one of the world's largest. Its people rely on fishing for more than half their protein. Russia, China, the United States and Norway are the other main fishing nations. Japan, Russia and Norway also have the world's largest whaling fleets. They hunt whales (which are mammals not fish) for their meat and for their oil. There is a danger that whales will become extinct unless whaling is curbed.

Among the many food fish caught in the oceans, the herring family are the most abundant. They live in near-surface waters and feed mainly off plankton. Equally important are the members of the cod family, which include cod, hake, whiting and haddock. These fish live near the bottom of the sea and, like herring, prefer northern waters. Mackerel, pilchard and sardine are found in warmer waters.

Anchovies prefer warmer water still, as does the large tuna (tunney). Flounder, halibut, plaice and sole are flatfish living on the bottom in northern and temperate waters. Large amounts of shellfish are also caught, among them prawns, shrimps, lobsters, crabs, oysters, mussels and clams.

Netting is the most common method of catching fish. In *trawling*, fishing boats drag an open-mouthed net along the bottom or at a set depth. In *seining*, a large net is drawn into a loop around the fish. *Gill netting* uses an upright floating net in which fish get caught by the gills. *Long-line* fishing is practised for bottom-dwelling fish such as cod and flat-fish. It uses long lines of baited hooks dropped onto the seabed. Tuna are fished with pole and line. Whales are attacked with explosive harpoons.

Ghanaian fishermen using nets to fish in Lake Volta, a man-made lake covering 8000 sq km.



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FARMING THE FORESTS

Conifers such as larch, spruce and pine are forested on a vast scale since they mature quickly.

The forests provide us with one of our most important materials – wood. One of the main uses of wood is in building. Some houses are built entirely of wood. Others have wooden doors, window frames, floors, joists and roofs. Most furniture is made from wood. Wood is also used as a raw material. Very large quantities are made into pulp to be made into paper. Among other products made from wood are cellophane; man-made fibres such as rayon; plastics such as cellulose acetate; and explosives such as nitrocellulose.

To provide the wood we need, an enormous number of trees are cut down, or *felled* each year. More than 15 trees may need to be felled just to make one tonne of white paper. In the past men felled trees from the forests without thinking of the future. But now they have realised that they must replant the forests with at least as many trees as they fell. The practice of looking after the forests is called *forestry*. Foresters try to protect existing forests from diseases, insects and fire. They collect seeds from the trees and raise seedlings in a forest *nursery*. Then they use these seedlings for replanting areas where trees have been felled.

The most widely used kind of wood is *softwood*. This is the kind most used in building construction and in pulp-making. Softwood trees include most cone-bearing trees, or *conifers*. The pines, larches, spruces, cedars and firs are among the most important. Most of them are *evergreen* – they do not shed their needle-like leaves all at once. Softwood forests grow mainly in the cool northern regions of America, Europe, and Asia.

Canada, Sweden and Russia are among the biggest softwood timber producers. In Canada the people who fell trees are known as *lumberjacks* ('lumber' is the North American term for timber). In all of these countries lumbering is a big industry. Felling is done these days with powerful chain saws. Machines such as tractors, bulldozers and trucks are used to extract the felled timber.

Hardwoods are in general tougher and harder than softwoods. They are widely used for making furniture, tool handles, and the like. Most hardwood trees have broad leaves and are *deciduous* – that is, they shed all their leaves in the autumn. Oak, elm, beech, ash, sycamore, maple, poplar and chestnut are important hardwoods. These trees thrive in warm, moist regions that have a long growing season. They are to be found in middle latitudes such as southern Canada, the United States, western and central Europe. Important hardwoods are found in tropical forest, too. Among the most important are mahogany, teak and ebony.

Some trees are grown not for their wood but for their sap. The most important is the rubber tree, which is grown on large plantations in Malaya, for example. From the sap of this tree rubber is made. In North America maples are grown for their sweet sap, from which maple sugar and syrup are made. Resin, turpentine and other useful oils are obtained from the sap of pines.

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MINING

Mining means digging into the ground for valuable minerals. It provides basic raw materials which other industries use. The most important of the minerals mined are the *ores*. These are minerals which can be processed to give metals. Haematite is a valuable iron ore. Bauxite is aluminium ore. Many other minerals are used as chemical raw materials, which manufacturers process into other substances. Iron pyrites (iron sulphide), for example, is roasted to produce sulphur dioxide gas. This is then turned into sulphuric acid, which is probably the most important of all the chemicals used in industry.

Quite a number of minerals are used just as they are. They include asbestos, which consists of mineral fibres; talc, which is used for talcum powder; and mica, which is used as an electrical insulator. A very special class of minerals are the *gems*. They are valued for their beauty and rarity. Diamonds, emeralds and sapphires are the most prized gems of all.

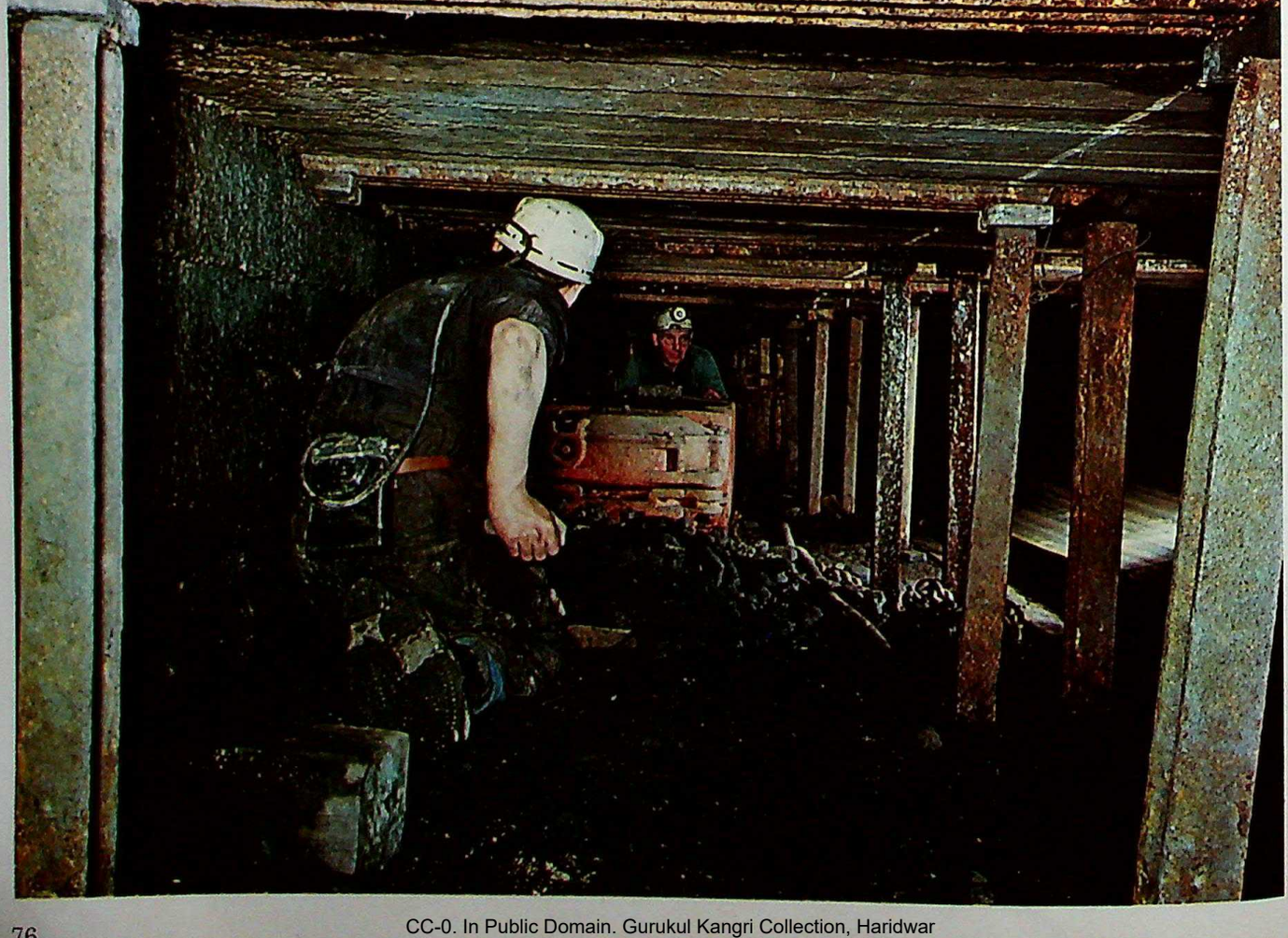
Coal is mined in very large quantities. It is sometimes called a mineral, but it is not like the other minerals. Most true minerals were formed by an *inorganic*, or non-living process. Coal was formed by an *organic*, or living process. It is the remains of tree-like plants which lived many millions of years ago. The main use for coal is as a fuel. But it can also be made into useful chemicals.

Mining is very different from the other basic industries, such as farming, fishing, and forestry. The products of farming, fishing and forestry are replaceable, under careful management. But the products of mining can never be replaced once they have been taken from the ground.

The United States and Russia are the two leading mining countries in the world. They have very large mineral resources, particularly iron ore and coal. Together they produce more than 300 million tonnes of iron ore and more than 1,200 million tonnes of coal every year. Fortunately supplies of iron ore and coal are quite plentiful, and should last for several hundred years more. But supplies of some minerals, including lead, gold and silver, could run out within 20 or 30 years.

Mineral Deposits

Great varieties of minerals are to be found throughout the rocks that make up the Earth's crust. But most rocks contain only small quantities of any particular mineral. Only here and there are minerals found in large concentrations, or *deposits*. Sometimes



Coal mining is highly mechanized these days. Coal cutters, mechanical loaders and conveyors are widely used.

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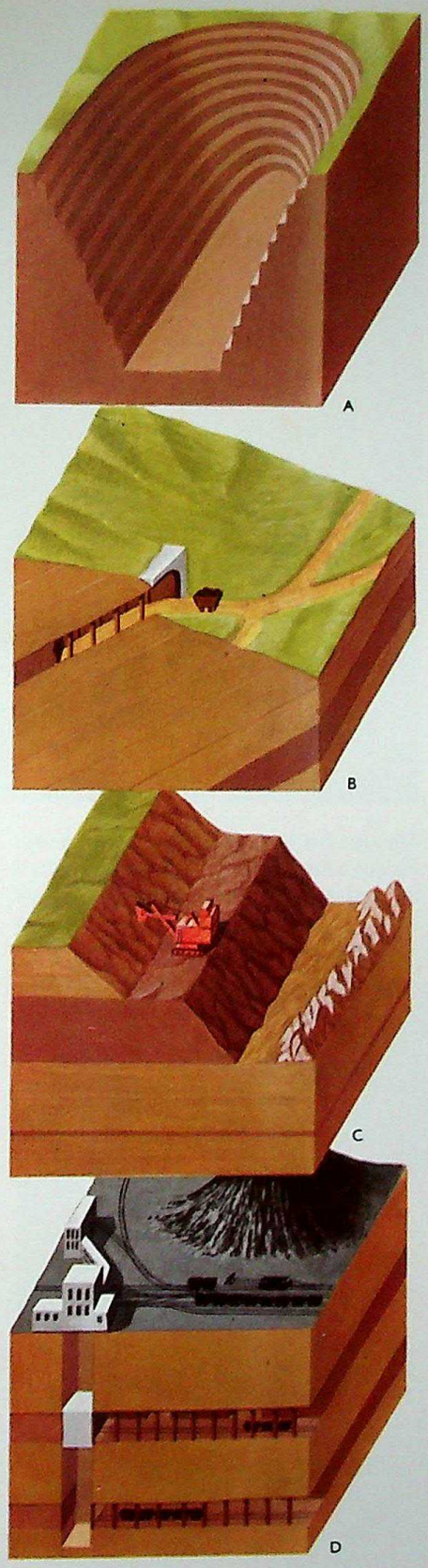
these deposits are rich enough for mining. But people take other things into consideration before they decide to open a mine.

One important thing is the depth of the deposit. A deposit that is worthwhile mining at the surface may not be worthwhile mining underground. Underground mining is very much more expensive. It is also much more dangerous for the miners, of course. The geographical position of the deposit also affects a decision to open a mine. If the deposit is located in a remote region, it may be difficult to find men to work the mine. Also there may not be any means of transporting the minerals from the mine to the industrial areas where they are to be used.

Mineral deposits may be formed in a variety of ways. Some deposits of heavy minerals are formed during rock formation, while magma (molten rock) is solidifying. The minerals crystallize early and sink through the magma. They then collect together to form a mineral-rich layer. Some chromium and iron-ore deposits are formed in this way. Some lodes may extend for several kilometres.

Other kinds of deposits are formed from liquid and gases which escape from some magmas. These liquids are rich in minerals. They rise upwards towards the Earth's surface through fissures (cracks) in the rocks. The higher they go, the cooler they become. And as they cool, they gradually deposit the minerals they contain. This kind of deposit is called a *vein* or *lode*. Copper, nickel, lead, zinc and silver ores are often found in lodes.

Another common type of deposit is the bedded deposit. Some bedded deposits are formed when shallow seas containing minerals evaporate in the heat of the sun. Gypsum and salt beds were formed in this way. Other bedded deposits are formed by the action of surface water. The water gradually passes downwards through the rocks and dissolves some of the minerals in them. Then it deposits the minerals in concentrated form in rocks underground or in lakes and seas. Many iron ores and copper ores were formed in this way.



Mining methods. In open-pit mining (A) successive terraces are cut. In (B) a seam is followed underground. In opencast or strip mining (C), ore is revealed by stripping off the soil. In underground mining (D), tunnels are driven to the ore deposits.

The action of surface water also gives rise to another kind of mineral deposit. Minerals in an exposed rock face are gradually broken loose by weathering. Streams then carry them along. The flowing water tends to sweep away the lighter rock minerals. The heavier ones tend to collect together at the bottom of the stream. Deposits formed in this way are known as *placers*. Among the heavy minerals found in placers are gold, diamonds and cassiterite (tin ore).

Prospecting

Looking for mineral deposits is called *prospecting*. In the past deposits were found when they occurred as outcrops on the surface. Today most undiscovered deposits lie underground, and scientific methods must be used to find them. First of all geologists study the surface rocks to find formations where they think certain minerals are likely to occur. Often they drill deep into the rocks to take samples. They may also survey the region from the air.

Geologists use many instruments to help them find mineral deposits. They use *magnetometers* to measure magnetism; *gravity meters* to measure how dense the rocks are; and *Geiger counters* and similar instruments to measure radiation. Sometimes geologists make *seismic tests* to find out what the rocks are like underground. In seismic testing a small explosion is set off in a hole in the ground to set up waves. These waves are reflected by underground rock layers back to sensitive instruments at the surface. The pattern of reflections gives an indication of the rock formations.

The World's Mining Regions

Workable deposits of minerals are spread unevenly around the Earth. One of the richest regions is North America. The great Canadian Shield region in the north contains a rich variety of minerals, including silver, cop-

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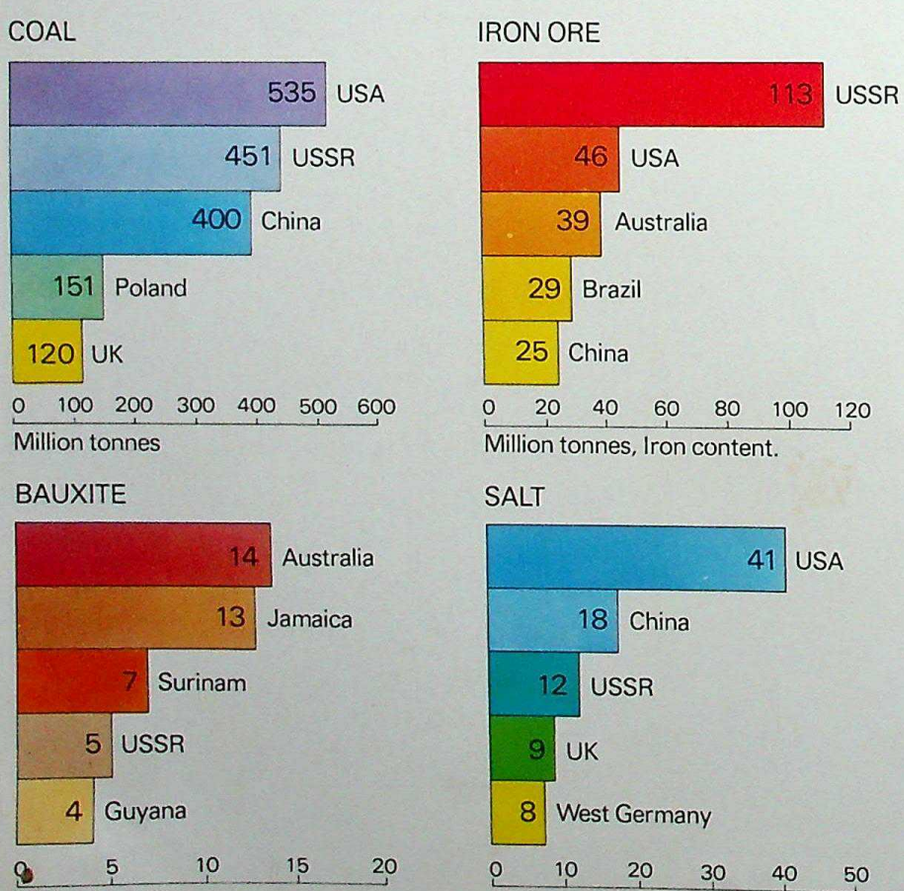
per, nickel, lead and zinc. So do the Rocky Mountains and the mountains and high plateaux in the south-western United States. The region around Lake Superior is a rich iron-mining area. In the West Indies, Jamaica produces the second largest amount of bauxite in the world.

Africa and Australia are also rich in many important minerals. Many massive deposits have been found and are already being worked. But it is thought that a great many more remain to be discovered. Some parts of these continents have not yet been properly explored. In Africa one of the greatest concentrations of copper ores in the world occurs in Zambia. The region is called the *Copper Belt*. Zaire (Congo) is also a major copper producer. South Africa is notable for its gold and diamond deposits, and produces more of these minerals than any other country. One of Australia's greatest mining areas is Broken Hill, in New South Wales. It produces large amounts of lead, zinc and silver. Mount Isa, in Queensland, a centre for mining copper, and also lead and zinc. Mines in Western Australia and elsewhere produce valuable amounts of gold, which make Australia the fourth largest gold-producing country in the world. Australia leads the world in bauxite production. The deposits at Weipa, in Queensland, are probably the largest in the world.

Above: An open-pit asbestos mine.
Below: Four of the world's most important mining products; coal, iron ore, bauxite and salt.



South America is another continent which has not been fully explored. Many more mineral deposits are bound to be found there in the future. The Andes Mountains near the western coast are especially rich in minerals such as silver, copper and lead. Peru is third in world silver production, after Mexico and Canada. Chile is third in world copper production, after the United States and Russia. Bolivia produces more tin than any other country except Malaysia. The deserts of northern Chile yield the world's greatest deposits of sodium nitrate, which is used as a fertilizer. It is called *Chile saltpetre*.

Western Europe is not particularly rich in valuable minerals compared with, say, North America. However, massive deposits of iron ores are found in several

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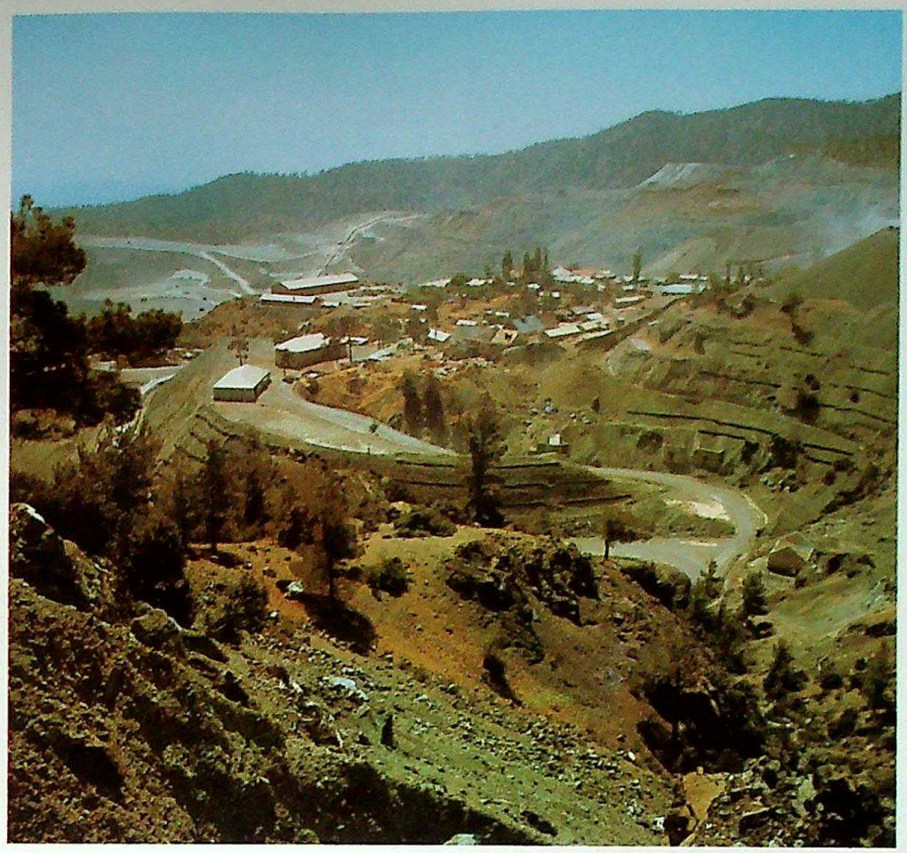


Above: China-clay or kaolin is taken from these quarries in Cornwall.
Below: Panning for precious gold in a stream in Borneo, SE Asia.

regions, including Belgium, Britain, France, Germany, Spain and Sweden. In Spain and Sweden the ores are of very rich magnetite and haematite. Similar rich beds of iron ore occur in the Ural Mountains in eastern Europe. This region has a wealth of other minerals, too, including gold, copper and lead.

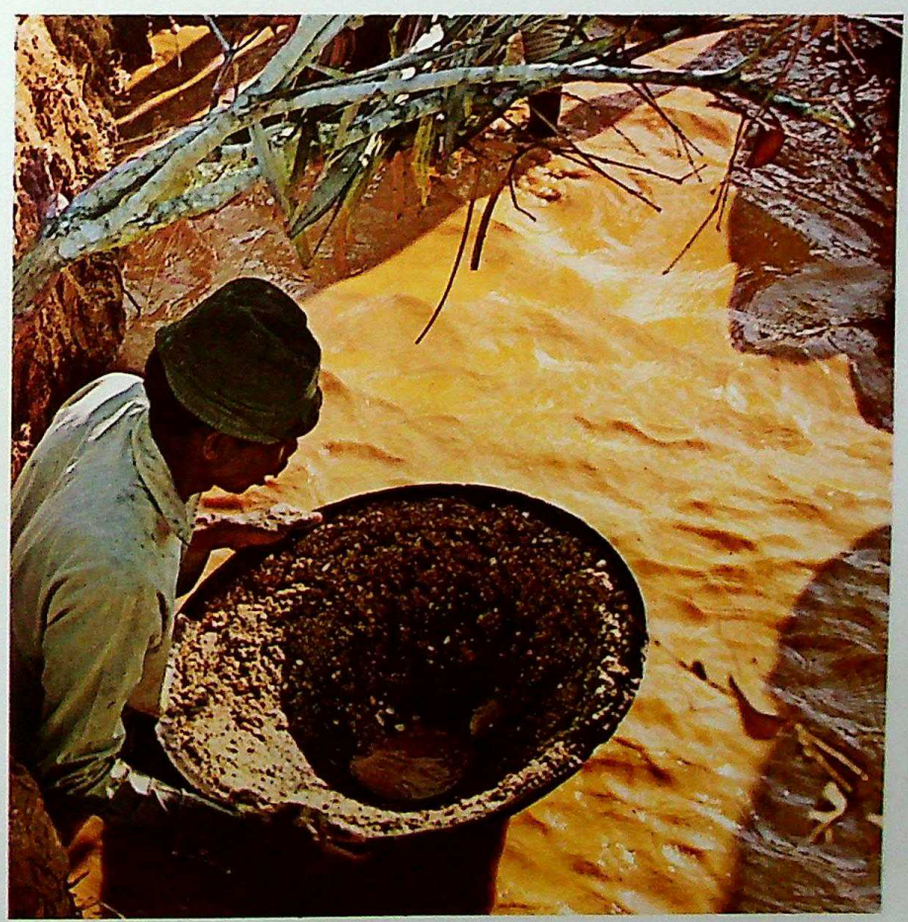
The Ural Mountains in effect divide Europe from Asia. The main mineral-producing regions in Asia are Siberia in the north and Malaysia in the south-east. Siberia produces many valuable minerals including gold, diamonds and uranium. Malaysia is the world's largest tin-mining region. The Middle East has few mineral deposits. Economically, however, the presence of vast petroleum deposits more than makes up for the lack of minerals. Some iron deposits are found in India and south-east Asia – particularly in the Malay peninsula and the Philippines. Some copper deposits are also found in the islands of south-east Asia.

Surface Mining

Sometimes deposits of minerals lie on or just beneath the surface of the ground. Mining is then relatively easy. Minerals mined from the surface include iron and copper ores, asbestos and bauxite (aluminium ore). Much coal is mined in this way, too. Most surface, or *opencast* mining is done with the aid of huge travelling excavators called *draglines*. These giant machines first strip off the layer of dirt, or *overburden*, covering the mineral deposit. After the overburden has been removed, the mineral deposit is then often broken up by explosives. Next, power shovels scoop up the broken deposit and load it into trucks or railway waggons. Sometimes it goes first to a crushing plant to be reduced in size. Stone and rock are often removed from surface pits in much the same way. Then it is called *quarrying*.

Opencast mines often cover vast areas. The great Bingham Canyon copper mine in Utah, USA, covers an area of more than 5 square kilometres (2 square miles). Over 300,000 tonnes of ore and overburden are removed from the mine every day.

Mining placer deposits may be



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done in various ways. Gold miners once used a hand method called *panning*. They put a few handfuls of soil in a pan and added water. Then they swirled it round and round. Any heavy specks of gold gathered in the middle, while the lighter material was washed over the edge of the pan. In placer gold mining today, gravel or soil is washed in *sluice boxes*. They have a ridged or cloth-covered bottom to catch the specks of gold as they settle out. When placer deposits occur in a river or lake bed, they are worked by *dredging*. Most of the world's cassiterite (tin ore) is obtained by dredging. Giant bucket dredgers can scoop up, wash, and sort thousands of tonnes of ore-bearing gravel every day.

Right: A Bolivian tin miner inserting a charge in the tin-bearing rock prior to blasting. Blasting will break up the rock and release the tin ore.
Below: Beautiful crystals of the mineral galena, which is the chief ore of lead. Traces of silver are usually found in galena ore bodies.

Underground Mining

When mineral deposits are found underground, vertical shafts must be sunk down to the right level. Then horizontal tunnels are bored to reach the deposits. Most minerals are freed from the rocks by drilling or blasting with explosives. Coal is unusual because it is quite soft. Therefore it can often be cut from the rocks by machines. When the mineral deposit has been blasted or cut loose, it is usually loaded into railway wagons or onto conveyor belts. It is then transported to one of the vertical shafts. From there it is hoisted to the surface by a lift, or *skip*.

The miners are carried between the surface and the tunnel levels in lifts called *cages*. In large mines they ride along the tunnels in carriages pulled by locomotives. Often the tunnels have to be supported by ribs and props to prevent them caving in, or collapsing. The main tunnels in a mine are usually lit by electricity. At the working face, however, miners see by means of helmet lamps. Good ventilation is provided in all mines. Fresh air is pumped in to give the miners oxygen to breathe and also to help keep them cool. Stale air is pumped out to help remove smelly and dangerous gases. Some of these gases could suffocate the miners or explode if they were allowed to remain. In many mines pumps have to be installed to keep the working areas free from water.

Gold mines in South Africa are among the deepest and biggest of all underground mines. The Western Deep Level Mine at Carltonville reaches a depth of more than 3 kilometres (2 miles). The temperature at that level is over 50°C (122°F). The East Rand Mine, in the famous Witwatersrand gold field near Johannesburg, is the world's largest gold mine. Placed end to end its main tunnels would stretch for over 4,000 kilometres (2,000 miles)!

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Any productive activity carried out by a group of people can be called an industry. Farming and fishing, for example, are kinds of industries. They are called *primary* industries, because they make direct use of natural resources. Forestry and mining are other primary industries. They provide raw materials which other industries use.

Secondary, or *manufacturing* industries take the raw materials and process them, that is, change them into useful products. Among the major manufacturing industries are the iron and steel industry, the textile industry, the chemical industry, the shipbuilding industry, the car industry and the aircraft industry.

The third main group of industries are the tertiary, or *service* industries. These are the industries that market and sell products and provide services to the consumers – the people who use them. This class of industry includes such things as wholesaling and retailing in shops, offices, banking, insurance and shipping.

In highly developed countries such as the United States, Japan, Britain and Russia, the manufacturing and service industries are the most important economically. In less developed countries such as India, the primary industries are more important.

Manufacturing Methods

Manufacturing means literally 'making by hand'. And until about 200 years ago, most goods were made by hand. Craftsmen worked by themselves at home or sometimes in small groups in workshops. In the 1700s however, things began to change, slowly at first and then more rapidly. Power-driven machines were developed to increase manufacturing output, first in the textile industries and then elsewhere. An Industrial Revolution took place. Industrialists installed many machines under one roof and hired labour to operate them. This marked the beginning of the *factory system*, which is the basis of manufacturing today.

Today, the widespread use of machines enables factories to turn out large numbers of goods quickly and cheaply. This is known as *mass production*. A

The supersonic airliner Concorde was designed and built jointly by aircraft companies in Britain and France and given financial backing by their governments.

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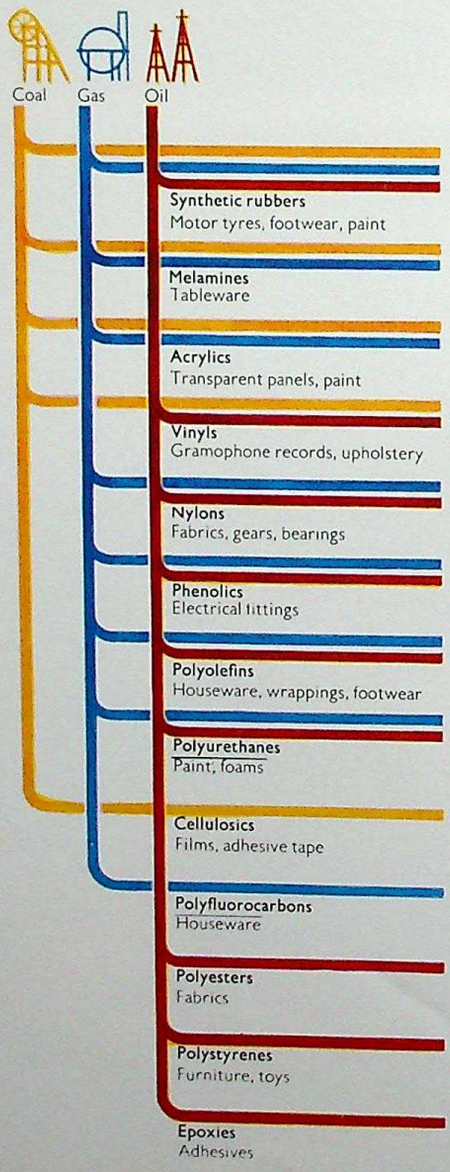
common method of mass production uses an *assembly line*. In assembly-line working a product is built up gradually from many separate parts. Workers stand in line and add a part as the product passes slowly by on a conveyor. Each worker has the same simple task to do, over and over again. The car industry provides the best example of assembly-line working. Henry Ford pioneered large-scale assembly-line car production in 1908. In this way he was able to produce cars cheaply for the first time. Assembly-line methods are now used to make all kinds of things from cameras, clocks and television sets to engines and aircraft.

Assembly-line manufacture depends on the fact that every nut, bolt, piston or gear wheel is identical to every other nut, bolt, piston or gear wheel being used for the same job. In other words, the parts are *interchangeable*. They are made by precision machine tools which turn, drill, cut, and grind metal very accurately. Many of the machines now being used in industry work automatically. They carry out a series of operations once they are switched on. The human operator is there merely to feed work into the machine.

In some industries machines controlled by a computer operate manufacturing processes without any human assistance. This is what is known as *automation*. A good example of automation is in an oil refinery. At the refinery there is a central control room which houses a computer. This is linked to numerous valves, heaters and pumps throughout the refinery. It is also connected to instruments that detect such things as the rate of flow of materials and the temperature and pressure at various points. Instructions are fed into the computer telling it what rates of flow, temperature and pressure there should be in various parts of the plant. And the computer continuously checks what is happening with what should be happening. If things are not quite right, it automatically instructs valves to open or close and heaters and pumps to turn on or off until things are as they should be.

Above: Assembling a watch in a Swiss watch factory.
Below: Plastics obtained from coal, gas and oil.



Location of Industry

Broadly speaking, industries did not spring up in a particular place by chance. They grew up there because of a number of factors. The most important of these factors are the availability of raw materials, power, labour and transport.

One of the most important factors is ready access to raw materials. The giant iron and steel works of the world are often sited close to iron-ore deposits or coal-fields. Large amounts of coal are required to produce coke for iron smelting. The Ruhr in Germany is one of Europe's main centres for steel production. It grew up alongside the iron ore and coal deposits found there. However, these days it relies mainly on imported ore. When large quantities of heavy raw materials are involved, it is usually cheaper and more convenient to establish an industry near the source of supply. For example, pulp and paper industries are usually found on the fringes of the timber forest. Brick kilns are often sited near claypits.

Many industries grew up around the coal-fields, which until fairly recently provided the chief means of power in industry. The coming of cheap electrical power brought a change. Electricity can be transmitted over long distances. Industries could be located in more convenient areas, where transport and other facilities were better. Some industries depend heavily upon cheap electric power. The aluminium industry is a notable example. Aluminium smelters are therefore often sited in areas where abundant hydroelectric power is available. Some hydroelectric power schemes have been undertaken just to supply electricity for aluminium smelting. One of the biggest is the Kitimat scheme in British Columbia, Canada.

A supply of suitable labour is obviously essential to any industrial enterprise. It is no use setting up a watch factory in an Australian mining town. The

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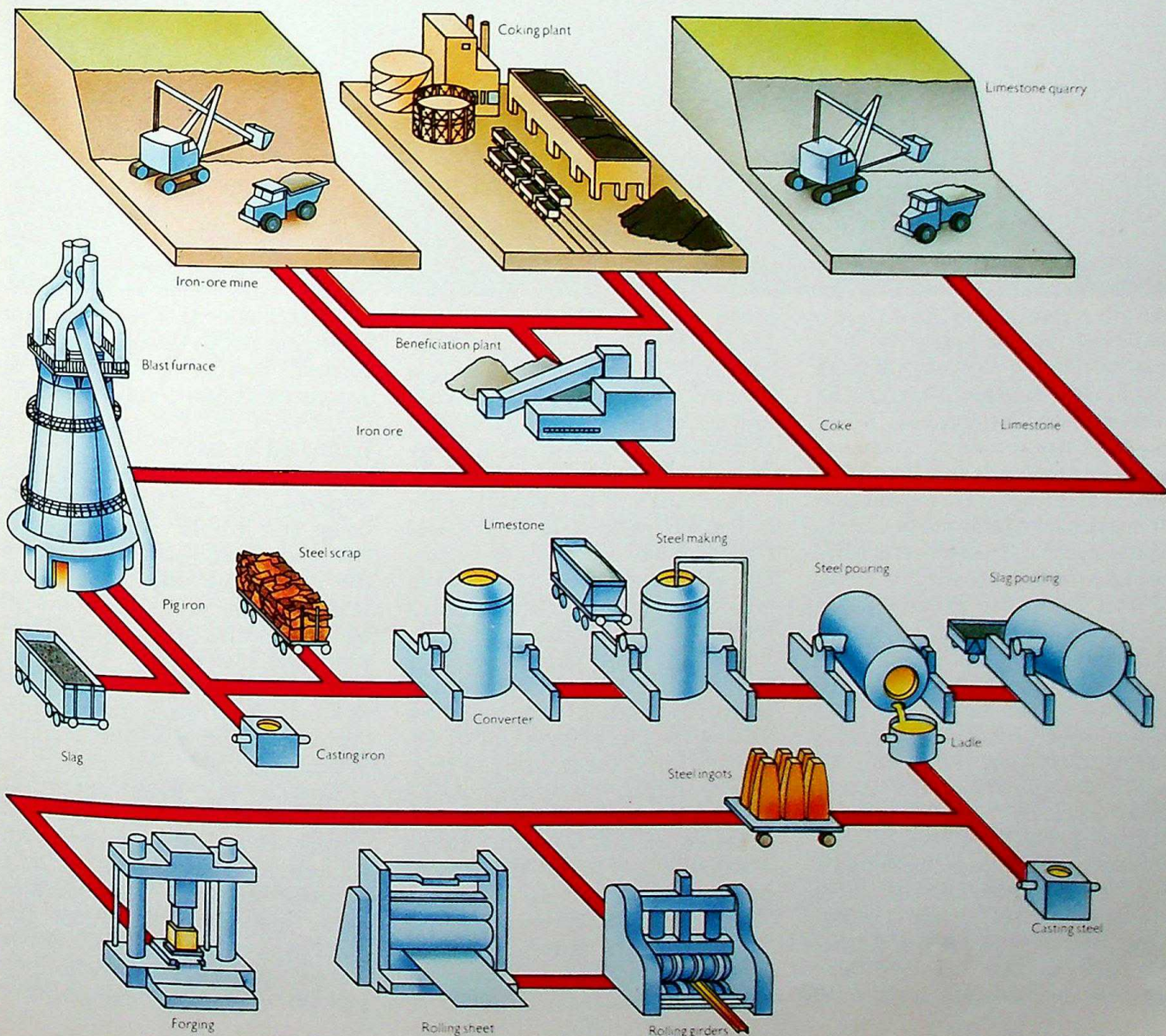
right kind of skilled worker would not be available. Thus industries of a particular kind often tend to stick together. In Britain, for example, the main centre for car manufacturing is the Midlands, where engineering industries had been long established. These days, however, workers are much more mobile and tend to travel wherever their skills are needed.

Good transport facilities are a particularly vital factor affecting the location of industries. Raw materials must be carried to the factories and works, and the products must be taken away. In many of the major industries water transport is of great importance. It is very suitable for carrying heavy materials such as coal and ore in bulk. It is also cheaper than other means of transport. Many industries are therefore located along rivers and canals. Many of the major ports are also centres of industry. They have ready access to raw materials by sea, and they also have excellent communications to markets inland. Hamburg in Germany and Antwerp in Belgium are two great industrial ports.

Iron and steel making. Iron ore, limestone, and coke (made from coal) are smelted in a blast furnace. The ore is reduced to impure iron, while earthy impurities form a slag. Some iron is cast directly. Most is refined into steel, often in a converter. Impurities form a slag, which is removed. The molten steel may then be cast directly, or formed into ingots, which are then shaped by forging or rolling.

World Industrial Regions

Combinations of the factors mentioned above have led to concentrations of industry in certain parts of the world. There are really four major industrial regions. One is Western Europe. A broad band of industry extends from Britain, over northern France, Belgium and Holland, and down through central and southern Germany to Poland and Czechoslovakia. Industry thrived because of the vast deposits of iron ore and coal found in the region. Major iron and steel centres are in South Wales and Tees-side in Britain and the Ruhr in West Germany. The Ruhr is a large region around the cities of Duisburg, Dortmund and Essen. It has one of the largest concentrations of industry in the world.



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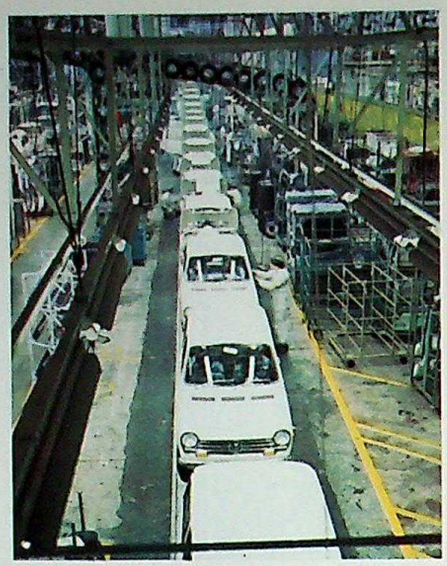
In France steel production is centred on Lorraine and along the Belgian border, where there are extensive coalfields. Most Belgian production comes from the Liège region.

West Germany and Britain are Europe's biggest chemical manufacturers. The Ruhr and Saxony are Germany's main productive regions. They use local supplies of coal and salts from the famous salt deposits in Stassfurt. In Britain Tees-side and Merseyside are the major chemical centres. Both are located near salt deposits. The chemical plants at Billingham and Wilton on Tees-side are among the world's biggest.

Italy also has a large chemical industry. It uses as raw materials deposits of natural gas in the Po Valley. The Po Valley lies in the Lombardy Plain in northern Italy, which has become one of Western Europe's most productive industrial regions. Most manufacturing takes place within the triangle formed by the cities of Turin, Milan, and Genoa.

The second of the world's major industrial regions is in the north-eastern United States, extending into southern Canada. Roughly speaking the region is bounded by the Great Lakes, the Mississippi and Ohio rivers, and the Atlantic seaboard. Major industrial centres include New York, Chicago, Pittsburgh, Buffalo, Detroit, Cleveland and Milwaukee. Pittsburgh is the centre of America's iron and steel industry. Detroit is the centre for car production. The industrial importance of the north-eastern United States arose because of the plentiful supplies of iron ore at the western end of the Great Lakes and of coal in the northern Appalachians (in Pennsylvania). Many of the centres mentioned lie on the Great Lakes, which provide excellent communications. However, the concentration of industry around the Lakes has caused them to become grossly polluted.

Smaller but important industrial regions are located on the Pacific coast of North America. One lies on the United States/Canada border around Vancouver and Seattle. Others lie in California around San Francisco and Los Angeles. Among the southern states, Alabama is important industrially because of the coalfields of the southern Appalachians. Birmingham is a leading centre.



Mass-produced Honda cars rolling off the assembly line. Japan has become a leading industrial nation in recent years.

Another major world industrial region lies in Russia. The great centre for Russian industry is the Donetz Basin in the Ukraine. There are also large industrial areas around Moscow, Leningrad, in the Urals and in the Kuzbass region of Siberia. Russia is well provided with coal, iron ore and many other minerals. It uses hydroelectric power on a large scale.

The fourth of the world's main industrial regions is Japan and China. Japan has made spectacular progress since 1945, when World War II ended. It now ranks with the United States and Russia as an industrial superpower. Its iron and steel, chemical textile, motor, and optical industries are among the foremost in the world. It leads the world in shipbuilding. Heavy industry is centred on the northern coast of Japan's southernmost island, Kyushu. Large coalfields are found there. The textile industry is centred on the Kobe-Kyoto-Osaka region of the main island of Honshu. Tokyo, Yokohama and Nagoya are other industrial centres.

China has been rapidly developing its industries in recent years. Industrial centres are growing in various regions. The north-eastern part of the country has centres at Tianjin (Tientsin), Anshan and Haerbin (Harbin). Shanghai and Guangzhou (Canton) on the western and southern coasts are also important.

Apart from the four major regions mentioned, there are a number of important smaller industrial regions. One is in north-eastern India, and includes the Calcutta area. This region has become one of Asia's main iron and steel centres because there is easy access to plentiful supplies of iron ore and coal. Calcutta is the centre of a large jute industry. Bangalore and Bombay have thriving industries.

In Australia most industrial activity takes place near the state capitals of Sydney, Adelaide and Melbourne. In Africa only the seaport Durban and the inland city of Johannesburg in the south have highly developed manufacturing industries. Near Johannesburg are found rich deposits of iron ore and the most productive coalfields in the whole of Africa. Industrial growth in South America has been hampered by lack of coal. The only major manufacturing region is in south-eastern Brazil, around Rio de Janeiro and São Paulo.

Iron and Steel

Iron and steel is by far the most important of all industries, because our whole civilization relies upon it so much. After steel the next most important metal is aluminium. Yet only about 10 million tonnes of aluminium are produced every year. This compares with over 600 million tonnes of steel! The United States, Russia and Japan are the leading producers.

Steel is our most important metal because it is hard and strong. It is not a pure metal, though. It is an iron *alloy*, or a mixture of iron with certain other elements. The most important of these is carbon. Other metals are added as well to give it better properties. The addition

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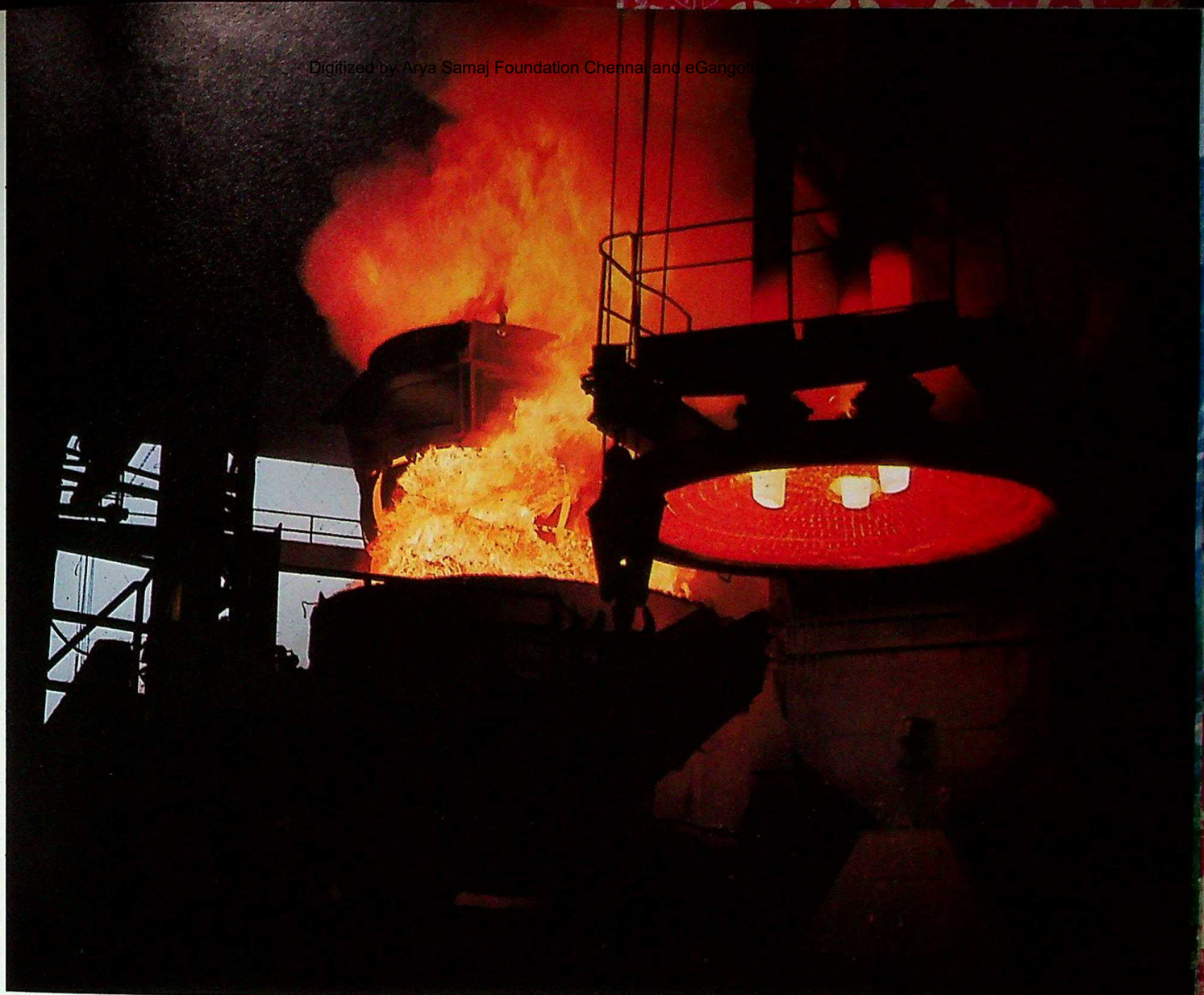

High-quality steel is refined in electric arc furnaces – like this. The picture shows the three glowing electrodes in the roof, which carry the electric current.

of nickel and chromium, for example, will prevent steel from rusting.

To make steel we first extract iron from its ores. Then we refine iron until it contains the right alloying elements. Then it becomes steel. Iron is obtained from its ores by *smelting*. In smelting, iron ore, coke and limestone are heated fiercely in a *blast furnace*. This is so called because hot air is blasted through to make the coke burn fiercely. Some of the coke reacts with the iron ore to form iron. Many impurities combine with the limestone to form what is called a *slag*.

The crude iron comes from the furnace as a red-hot molten stream. It is then taken in giant ladles to the steel-making furnaces. In these furnaces it is often mixed with more ore and steel scrap and reheated to a high temperature. Sometimes a jet of oxygen is blown onto it. This helps burn out the impurities. The steel can be shaped while it is still molten by casting. Hot solid steel can be shaped by forging (hammering), pressing, rolling, and other methods.

There are few industries indeed which do not rely on steel products. Many industries use massive amounts of steel. They are often called heavy engineering industries. Foremost among them is the shipbuilding industry. Practically all ships' hulls are constructed by welding thick steel plates together. Tens and even hundreds of thousands of tonnes of steel plate may be used to build a large ship. Boilermaking is another heavy engineering industry. So are engine-building and railway engineering. Heavy engineering industries are generally located close to steel-producing regions.

The chemical industry uses large amounts of steel to build pipes, reaction vessels, distillation towers and other equipment. The car industry uses steel for car bodies and many other components, and cast iron for engine blocks. Steel is widely used in the construction industry. It is used, for example, for the frames of skyscrapers; the reinforcing (strengthening) rods for concrete; and the towers, cables and decks of suspension bridges. The food preservation industry is another major steel user. The so-called 'tin' cans used for canning foods are in fact thin steel sheet coated with tin.

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ENERGY & POWER

Over the years Man has discovered many ways of making his life more productive and more comfortable. He has discovered the usefulness of metals and found how to smelt them from their ores. He has invented ingenious machines to help him at his work. He has discovered chemical processes that provide him with dyes, drugs, plastics, fibres and other useful materials. He has developed powerful engines and means of transport that enable him to travel far and wide – even to the Moon. He has built comfortable houses to live in.

To fashion his world in the way that he has, Man has needed vast supplies of energy. We still do. In fact we have been using so much energy in recent years that there is a worldwide energy crisis. Soon there will not be enough energy to go round.

The main sources of energy in the world today are petroleum, natural gas and coal. They are fuels, which release their energy when they are burned. They are taken from the ground, where they were formed hundreds of millions of years ago. They are called *fossil fuels* because they are the remains of plants and animals that lived long ago. The trouble with these fuels is that they cannot be replaced once they have been used up. It is probable that supplies of petroleum and natural gas will dry up in less than 100 years, though coal should last much longer.

One of the main uses of the fossil fuels is in power stations, which generate electricity. Electricity is a most convenient source of power because it is clean and silent, and it can be sent over long distances. Much electricity is also produced by harnessing the energy of flowing water. This is done at hydroelectric ('water-electric') power stations. In the world as a whole about a third of the electricity is produced by hydroelectric power, while two-thirds is produced by fuel-burning power stations. Hydroelectric power stations have the advantage that their source of energy will never give out.

Another increasingly important source of energy is atomic, or nuclear energy. This is the energy which is hidden in the atoms that make up matter. Certain atoms can be made to give up this energy. Uranium is one of them. It is used as a 'fuel' in nuclear reactors. Reactors produce heat which can be used to generate electricity. Uranium is such a good 'fuel' that a kilogram of it can produce as much energy as 3 million kilograms of coal!

Some of the other sources of energy in Nature are being tapped for our use. We have already mentioned the power of flowing water. There is also the power in the wind. We have harnessed this by building sailing boats and windmills. Windmills gradually went out of use when steam power became available. But in recent years interest in them has been revived. Groups in many countries are involved in wind-power projects, in which huge propellers spun by the wind turn electricity generators.

There is also great interest in solar energy, or the energy the Sun pours out day by day. In some countries solar energy is already being used on a small scale to heat homes. Most spacecraft are powered by solar cells, which produce electricity from sunlight. Some scientists have even suggested that we should build huge satellites covered in solar cells and transmit the electricity they produce back to Earth.

Another useful source of energy in some areas is the heat in hot springs and geysers. It is known as *geothermal* ('hot-earth') energy. There are hot springs and geysers in Iceland, New Zealand, Italy and California. In each of these regions geothermal energy is now being tapped. For example, in the Icelandic capital city, Reykjavík, all the houses are heated by hot water from underground.

Left: Cut peat in Ireland. When dry, peat is useful fuel.
Right: Steam produced in the Earth is harnessed at this geothermal power station at Waisakei, New Zealand.

Coal

Coal is the decayed remains of gigantic plants that lived on the

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Battersea Power Station, in London, which burns coal in its steam-generating boilers.

Earth up to about 350 million years ago. The plants were giant ferns and horsetails, which grew in swampy ground. When they died, they fell into the swamp floor and began to decay. In time they became covered with layers of mud and sand. As the layers above them pressed down, the decayed remains became drier and harder. In time the sand and mud layers became sedimentary rocks, and the decayed plant remains became coal. The heat in the Earth's crust also helped the coal-making process.

Coal is found in many parts of the world, and is used on a vast scale. Russia and the United States are the biggest producers. China, Britain and West Germany also produce large amounts. Total world production is about 3,000 million tonnes a year. Coal is mined both at the surface and underground. It usually occurs as thick seams in the rock layers. Being soft, coal can be cut from the rocks by machines.

Not all coal is the same. The best is *anthracite*, which is hard, shiny and jet black. It has the highest heating value among coals. *Bituminous coals* are softer than anthracite and dirtier. Their heating value is less than anthracite, but greater than the lowest grade of coal, *lignite*. Lignite, which has a dirty brown colour, contains quite a lot of water. Bituminous coal is the most widely used. Some is burned in furnaces to produce heat. Some is heated strongly without air when it changes into *coke*. Coke is a valuable fuel and raw material, particularly for the iron and steel industries.

When coke is produced by heating coal, gas and vapour are given off too. *Coal gas* contains flammable gases such as hydrogen and carbon monoxide. It has long been a very important fuel. The vapour changes into a liquid, *coal tar*, when it cools. Coal tar contains a large number of useful chemicals called *hydrocarbons*. From these hydrocarbons we can make such things as dyes, drugs, perfumes, insecticides, plastics and explosives.

Oil and Natural Gas

Oil and natural gas are the remains of tiny plants and animals which lived in shallow seas hundreds of millions of years ago. When they died, their bodies drifted to the sea bed and began to decay. Then they became covered with mud and clay. Gradually the decaying remains changed into droplets of oil and bubbles of gas. This change was helped by the heat and pressure of the surrounding rocks. In time the oil and natural gas moved into porous rocks, that is, rocks with tiny pores (holes) in them. They moved up through these rocks until they became trapped by impervious rock layers – those which had no pores. The tiny droplets of oil merged together to form a pool, or *reservoir*. Sometimes the natural gas collected above the reservoir. Sometimes it became trapped elsewhere.

Finding and tapping the underground pools of oil and pockets of natural gas is often a difficult and expensive task. Oil geologists first search for rock formations which could hold oil or gas (see page 77). Then engineers drill a hole into the rocks at a likely spot. Often they have to drill down thousands of metres before reaching oil or gas. A gas well in Oklahoma, drilled in 1972, is more than 9 kilometres ($5\frac{1}{2}$ miles) deep.

Drilling is done from a *drilling rig*, whose most striking feature is the pipe-lifting tower, or *derrick*. Drilling for oil offshore is done from floating, or semi-floating rigs. In drilling, a hole is bored in the ground by a rotating cutting bit at the end of a long string of pipes. The uppermost pipe is gripped and turned by a *turntable* driven by an engine. New sections of pipe are added to the string as the hole goes deeper. If oil is struck, the borehole is capped with an arrangement of valves (called a Christmas tree) and becomes a producing well. From the well the oil is sent to *oil refineries* for processing. It may be sent overland by pipeline or overseas by oil tanker.

Crude oil from the ground, like coal tar, is a mixture of many hydrocarbons. At the oil refinery this mixture is split up into several parts, or *fractions*. The main fractions are petrol, kerosene, diesel oil and fuel oil, all of which are very important fuels. Lubricating oil, greases and tar are other refinery products. Many of the gases produced during refining are valuable raw materials for the chemical industry.

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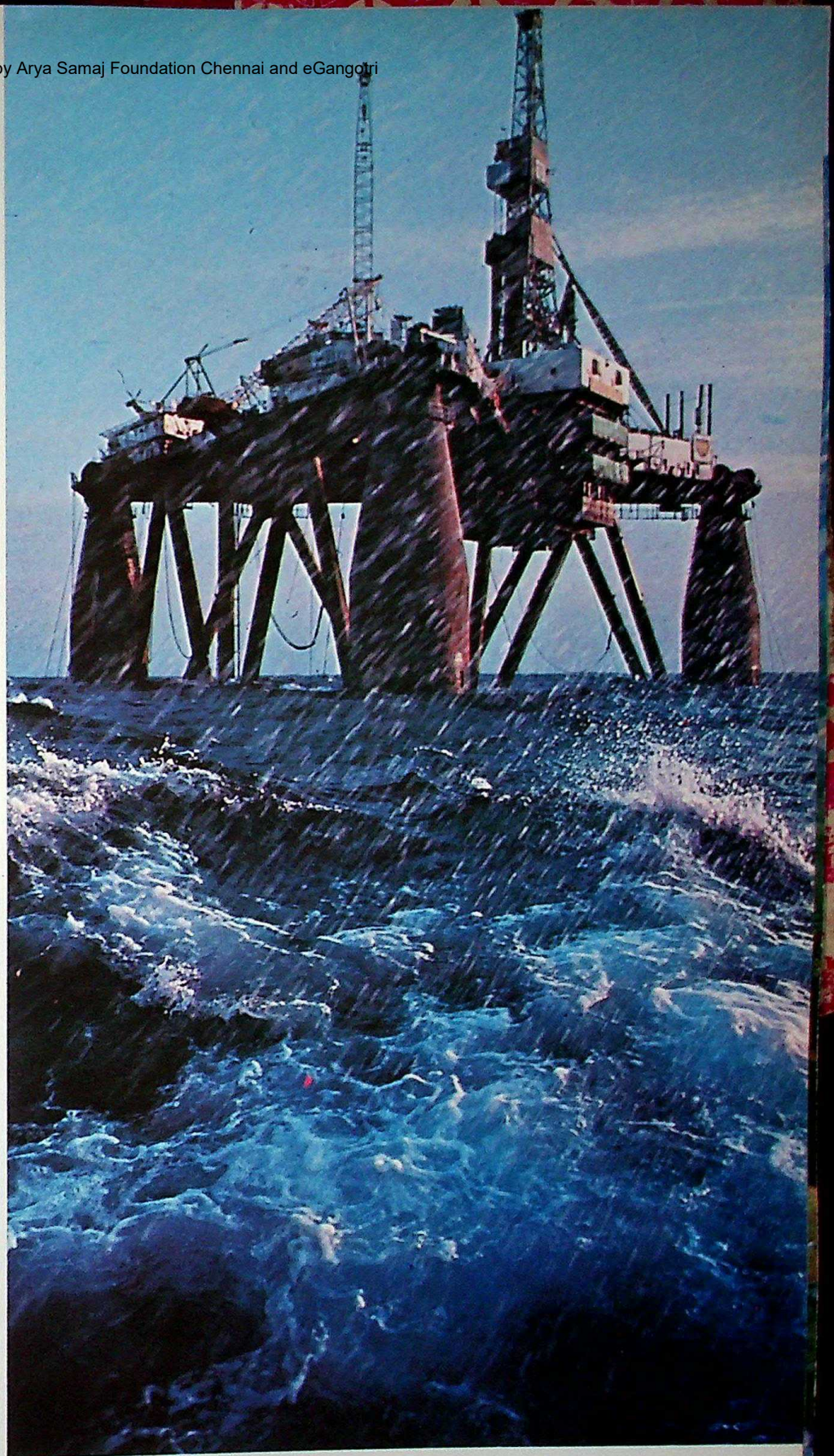
The main oil-producing region of the world is the Middle East. The countries of Saudi Arabia, Kuwait, Iran and Iraq are the leading producers. Together they produce more than 4,340 million barrels each year (1 barrel = 160 litres or 35 UK gallons). Large oil-fields are worked in North and South America. Vast deposits have recently been found in northern Alaska. Alberta has Canada's largest oilfields. The United States has rich fields along the Gulf of Mexico in Texas and Louisiana, and also in Oklahoma, Arkansas, Kansas, and southern California. It produces more than 3,500 million barrels a year. In South America, Venezuela is the biggest producer. Across the Atlantic, large deposits of oil have recently been found under the North Sea, mainly in English and Norwegian waters. Russia's main oil-producing areas are Baku on the Caspian Sea and the Volga-Urals region farther north. Libya is Africa's major producer.

Nuclear Power

In an ordinary power station electricity is produced by burning coal or another fuel in a furnace. The furnace heats up water in a boiler which changes into steam. The steam is led into steam turbines and spins them round. The steam turbines are linked to generators, which produce electricity when they spin. In a nuclear power station it is the heat produced by a *nuclear reactor* which changes water into steam.

The most important part of a nuclear reactor is the core of *uranium*, or a similar material. Under certain conditions the atoms of uranium can be made to split, or undergo *fission*. When fission occurs, an enormous amount of energy is released as heat and radiation. A nuclear reactor provides just the right conditions for fission to occur safely. Heat is removed from the reactor core by passing a cooling fluid, or *coolant*, through it. The hot coolant then passes through a *heat exchanger*. In the exchanger it heats up water and turns it into steam for the turbines. Various fluids may be used as coolants, including boiling water, carbon dioxide gas, and liquid sodium metal.

The United States, Britain, France and West Germany all have large nuclear power programmes. By 1976 more than 70 nuclear power stations were in



The drilling platform *Sea Quest* drilling in the North Sea, where vast deposits of oil and natural gas have been found in recent years. The biggest fields lie in Norwegian and British waters. The first British North Sea oil, which is of excellent quality, came ashore in 1975.

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operation throughout the world. At least the same number were being built. Many more are planned. Some people believe however, that it will be wrong to build too many nuclear plants. This is because the plants produce very dangerous waste materials, which give out damaging rays. Getting rid of such wastes poses a serious pollution problem to the environment.

Hydroelectric Power

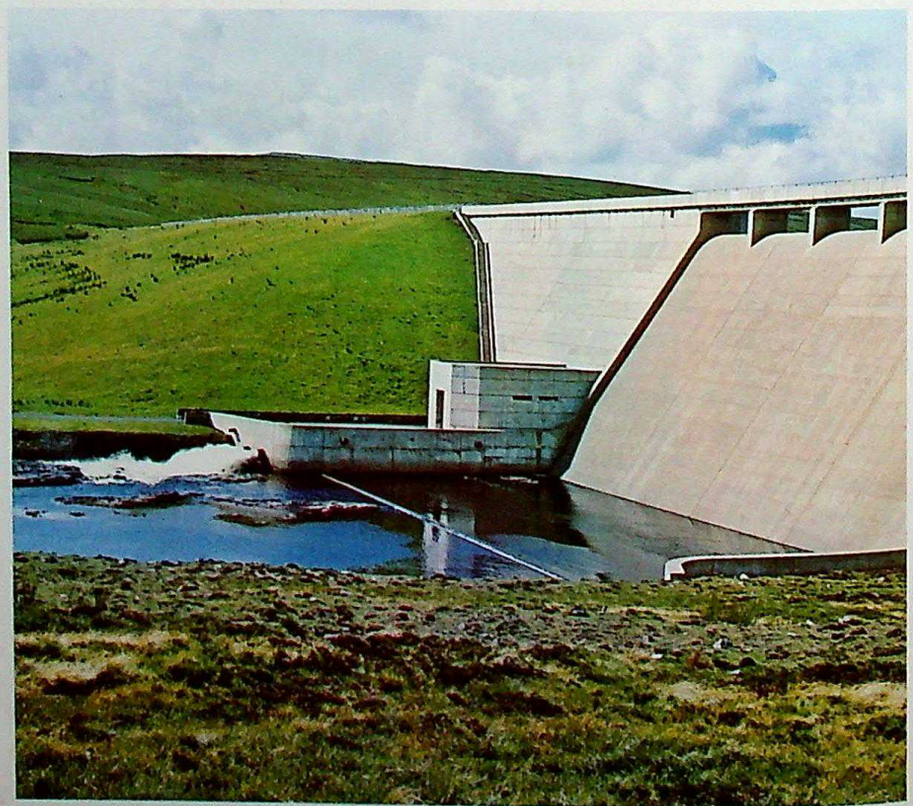
No pollution problems are posed by this source of power. Flowing water has been used to produce power for hundreds of years. In past years this was done by using a *water-wheel*, which was spun by water flowing over or beneath it. Nowadays *water turbines* are used instead. Flowing water is directed onto the blades of the turbines and spins them round. The turbines are coupled to generators, which produce electricity.

To spin the turbines efficiently, a large fall, or 'head' of water is required. So hydroelectric power stations are usually located in mountainous regions. Often dams are built across river gorges to create a greater head of water. Among the many large hydroelectric-dam projects completed in recent years are those at Aswan in Egypt and Kariba on the Zambia/Rhodesia border. The building of the Kariba dam created an artificial lake 280 km (175 miles) long.

The United States is the biggest producer of hydroelectricity in the world. It produces more than a quarter. It has large stations on the Colorado, Columbia and Sacramento Rivers, and in the Tennessee Basin. It shares the Niagara station with Canada, which is the world's second biggest producer. In the United States hydroelectricity accounts for about one-fifth of the electricity produced. In Canada it accounts for three-quarters of the electricity produced. Other countries, such as Switzerland, rely almost entirely on hydroelectricity.

Another type of hydroelectric-power station has been built on the River Rance, in Britanny, France. It harnesses the rise and fall of the tides. Similar schemes have been planned for the Bay of Fundy on the east coast of Canada and have been suggested for the River Severn in south-west England. At both of these sites there is a large rise and fall of tide (12 metres, 40 feet, or more).

Above: The nuclear power station at Dodewaard, in the Netherlands, opened in 1969. In a nuclear power station, energy is obtained from the splitting of uranium atoms.
Below: A hydroelectric dam in Upper Teesdale, England.



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Good communications by land, sea and air are essential in the modern world. They allow the ready movement of people, foodstuffs, raw materials and manufactured products from town to town, country to country, and continent to continent.

Broadly speaking most of the local traffic in a region is on the roads. Cars and buses carry people to work, on shopping trips, on visits, and so on. Lorries carry the bulk of the heavy goods from manufacturers to wholesalers and to shops. Road transport between cities is relatively quick. But in large towns it can be very slow because of all the vehicles on the roads. For longer distances the railway has advantages. It can carry passengers and large amounts of goods quickly and economically in comfort and safety. Rail transport is not as flexible as road transport, though, because it runs on a fixed track.

Where distances of hundreds of kilometres are concerned, the aeroplane is often the answer for passengers. It is much more expensive than alternative forms of travel, if there are any. But many people are prepared to pay the extra because plane travel is so very much quicker. For example, whereas the fastest sea liner takes over three days to cross the Atlantic, a jet airliner takes only 6 to 7 hours. However, ships still carry by far the largest amount of overseas cargo or freight. Air transport of freight is usually limited to small articles of high value, mail or perishable cargoes.

Pipelines have become an important means of transporting selected materials in some countries. The largest networks of pipelines are in North America, where more than 300,000 km (200,000 miles) of piping carry crude oil and petroleum products. Oil and gas pipelines of great length are also in operation in Russia and the Middle East. Pipelines are very expensive to install but they are cheap to run.

Before we go on it is worth remembering that in some regions of the world there are few modern means of transport. And the people still use the traditional methods. In tropical Africa, for example, human porters are still used to carry loads. Mules are often used as pack animals in rugged mountainous regions. So are camels in the Arabian and African deserts, and llamas in the Andes Mountains. Draught animals – those which draw loads on carts – are still common in many

Italy's Autostrada del Sol (Highway of the Sun), snaking through the Apennines.

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parts of the world. In Africa and Asia bullocks and water buffalos are widely used. The horse is still used in some parts of Europe.

Climate and Geography

The climate and the lie of the land can have a great influence on transport and communications. On land, mountains and rivers form the chief obstacles to traffic by road and rail. Roads and railways cannot be made steep. Cuttings and embankments and even tunnels may have to be built to make the route suitable. This is very expensive. Where possible, *passes* (gaps) in the mountains are used, such as the Brenner Pass in the Alps and the Khyber Pass in the Himalayas. Across rivers, estuaries and valleys, bridges have to be built. Again, this is an expensive operation. However, building a bridge may sometimes serve to short-cut an otherwise rambling route.

The effect of the weather on communications can be deadly. Roads become dangerous when ice forms on them. After heavy falls of snow they quickly become impassable. Railways suffer from iced-up points. Fog causes chaos everywhere, making driving difficult and preventing planes from taking off and landing. Stormy weather signals danger for ships, for wind-blown waves have tremendous power. Aeroplanes can also get into difficulties in storms. However, the weather affects them mainly when taking off and landing. When they are at cruising height (often 8 km, 5 miles), they fly above the weather.

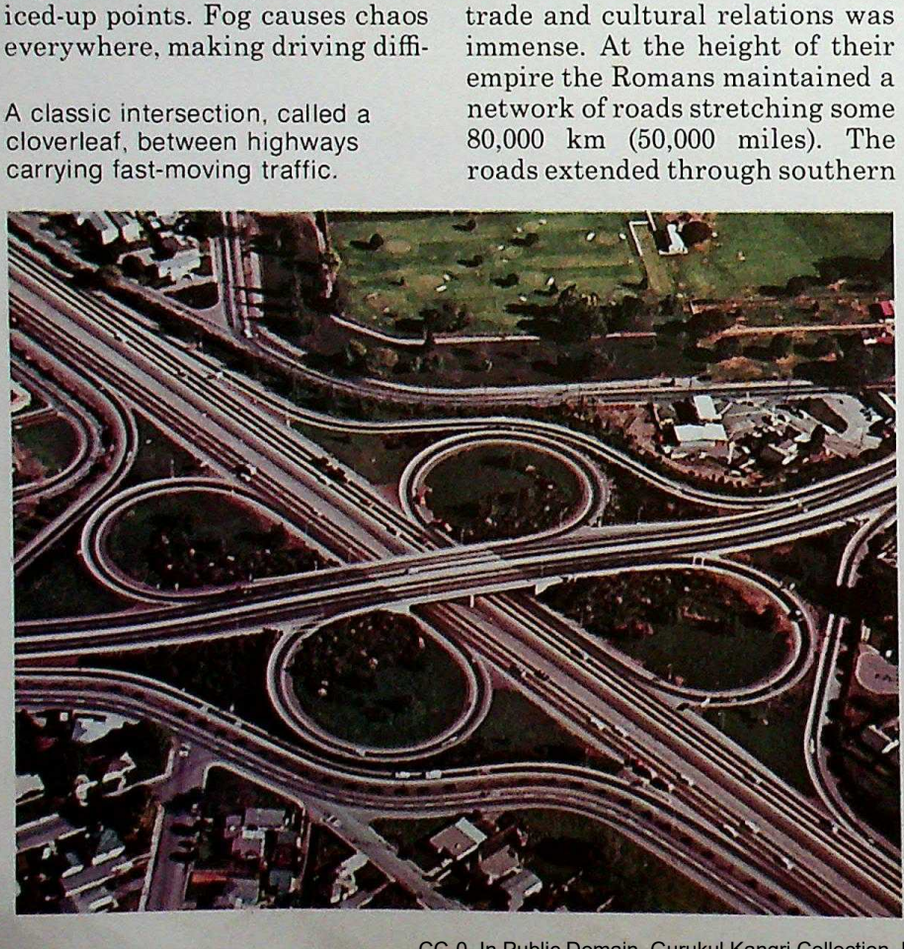
Heavily forested tropical regions pose a difficult barrier to communications, as do deserts. In desert regions the sheer heat can cause machines and equipment to fail. Drifting sand can quickly engulf railway tracks and roads and clog up machinery. In contrast building roads and railways in extreme northern regions is made difficult by the very low temperature and the permanently frozen ground.

Crowds of commuters like these place great strain on transport systems in the rush hours.

Roads

Most of the early civilizations appreciated the value of good communications by road. The Romans in particular were skilled road builders. The main reason for building them was military. But their value in broadening trade and cultural relations was immense. At the height of their empire the Romans maintained a network of roads stretching some 80,000 km (50,000 miles). The roads extended through southern and western Europe and as far north as northern England. They stretched through the Balkans to the Middle East and along the Mediterranean coast of Africa.

A classic intersection, called a cloverleaf, between highways carrying fast-moving traffic.



Roman roads were built up of several layers. They had a base of large stones, on top of which were layers of rubble and a kind of concrete. Then came a thicker layer of broken tiles or bricks. On top was a layer of flat paving stones. The roads had a curved surface, or *camber*, to allow rain water to drain off.

After the Roman Empire declined, the roads went to rack and ruin. It was not until the early 1800s that road building began in earnest again. The two great pioneers were the English engineers Thomas Telford and James McAdam. McAdam's road surface consisted of layers of broken stone on a rammed dirt base. We still use the term *macadam* for this kind of surface. Nowadays tar is mixed with crushed stone to give a tarmacadam, or *tarmac*, surface. Some modern roads are made of large slabs of concrete.

Practically all developed countries have extensive road networks. In Europe most of the

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roads are winding and narrow. They follow much the same pattern as they did centuries ago. But over the last 50 years special roads have been built for high-speed traffic. They are called such names as *motorway* (Britain), *autobahn* (Germany) and *autostrada* (Italy). These roads cut straight across the countryside and have gentle bends and gradients (slopes). They have two carriageways, to separate traffic moving in opposite directions. They can be joined only at a few points, at special multi-level *intersections*.

In the United States roads in general are much straighter and wider than they are in Europe. They did not have to follow ancient boundaries as the European roads did. The United States has more than half of the world's motor vehicles, and has the best-developed road system in the world. Many are motorway-type roads, called *expressways* or *turnpikes*. Turnpikes are *toll roads*, that is, drivers have to pay to use them. Recently completed is the 66,000-km (41,000-mile) long Interstate Highway System, which criss-crosses the country.

Railways

The railways developed on a large scale from about 1830 onwards. In most countries they had a marked effect on the pattern of settlement. This was most apparent in North America, which had relatively few settlements inland before the railways came. Towns sprang up along the path of the railways, and became trading and cultural centres for the surrounding areas. The building of the transcontinental railway in particular helped unite the rapidly developing communities. The great trans-American line across the Rocky Mountains joined the Union Pacific and the Central Pacific networks. It was completed in 1869. Easy travel between the East and West became possible for the first time.

In already developed countries such as Britain, the railways provided the capacity to carry raw materials and goods to and from the rapidly expanding industrial centres, the mines and the ports. Today the railways are less important than they once were, because of the development of the car, lorry and aeroplane. Yet they still carry appreciable amounts of freight, particularly heavy freight such as coal and ore. Long-distance passenger traffic is much lighter than it once was. But many businessmen use relatively short-distance trains to travel daily to work in the large towns from outlying areas. They are often called *commuters*.

A twin-track monorail system in Tokyo. This novel kind of railway is not yet widely used.

Steam locomotives used to haul trains in the early days, but few remain today. Their place has been taken by cleaner and more efficient diesel and electric locomotives. Locomotives powered by gas turbines are also in service in some countries, notably the United States, Russia and France.

Rail speeds have increased greatly in recent years. Britain's High Speed Train has exceeded 225 km (140 miles) an hour. Some Japanese trains travel even faster.

Water Transport

The oceans carry the bulk of the world's cargo between the continents. Ships are a slow form of transport, but they can carry far greater loads than anything else can. The largest ships afloat are oil tankers. The Japanese tanker *Globtik Tokyo*, for example, is 379 m (1,243 feet) long and 62 m (203 feet) across. Coal, grain, ore and timber are also shipped on a large scale around the world. Some ships carry general cargo. Others are more specialized; for example, they may have refrigerated holds to carry meat, fruit and dairy produce.

Most cargo-carrying ships, or *freighters*, run on regular schedules and travel on regular routes. *Tramps* are ships that go wherever and whenever there is cargo to be collected and delivered. *Coasters* are small vessels that travel up and down the coast, distributing goods from port to port. The ports provide a sheltered anchorage for shipping and facilities for handling cargo. They have good communications by road, rail or inland waterway with the regions they serve.

Most ships travel along well-established shipping routes, or lanes. The busiest of these routes are across the North Atlantic between European ports such as London, Liverpool, Rotterdam and Hamburg, and North American ports such as New York, Philadelphia and Montreal.

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Two great ship canals play a vital role in world shipping. The first is the Suez Canal (opened in 1869), which connects the Persian Gulf and the Mediterranean Sea. By using the canal ships travelling between Europe and the Far East avoid the long route around southern Africa. The other main international ship canal is the Panama (opened in 1914) in Central America. By using this canal, ships avoid the long, dangerous voyage around Cape Horn at the tip of South America.

There are important ship canals in several countries, which allow ships to sail from the sea to inland waterways. The St Lawrence Seaway in Canada, for example, allows ocean-going ships to sail into the Great Lakes and serve inland ports such as Chicago and Toronto. There are many important ship and barge canals in Europe, particularly in the Netherlands, Germany and France. The North Sea Canal allows vessels to sail inland to Amsterdam; the Kiel Canal connects the North Sea with the Baltic. Many other canals connect Europe's great navigable rivers, including the Rhine, Rhône, Marne, Main, and Danube. One of Russia's main waterways is the Volga-Baltic Canal.

Navigable rivers still play a major part in communications in many parts of the world, as they have done from the earliest times. In South America the Amazon and Paraná rivers provide the only means of transport in some regions. In the United States the Mississippi, Missouri and Ohio rivers carry much commercial traffic. In Africa the Nile, Zaire (Congo), Niger and Zambezi provide ready transport along much of their length. In places, though, rapids and waterfalls prevent navigation. In the East one of the greatest navigable rivers is the Yangtze.

A 215,000-tonne tanker off Cape Town, carrying crude oil from the Middle East.

A British Airways Jumbo Jet in flight.

Air Transport

The aeroplane was invented in 1903, but air transport on a large scale did not develop until the 1930s. It expanded greatly after World War 2 (1939–1945). In the 1950s the present generation of jet airliners was born. Jet airliners travel very fast – often at speeds of over 1,000 km (620 miles) an hour. Some of them are very big. The Boeing-747 airliner, which is often called a *jumbo jet*, is one of the largest. It is 70 m (231 ft) long, has a wing-span of 60 m (195 ft), and weighs 366 tonnes.

Planes are very fast, but their engines burn large amounts of fuel. They are also very expensive to design and build. The airports that handle them require large amounts of space, equipment, and large numbers of personnel. Air travel is therefore expensive compared with other forms of transport. But in some regions convenient alternative forms of transport do not exist, or are ill-developed. In the Australian outback, for example, the plane plays a vital role in ferrying supplies and giving medical aid to isolated communities. The United States, Canada and Russia also have well-developed internal airways to bridge the great distances between their wide-ranging states or provinces.

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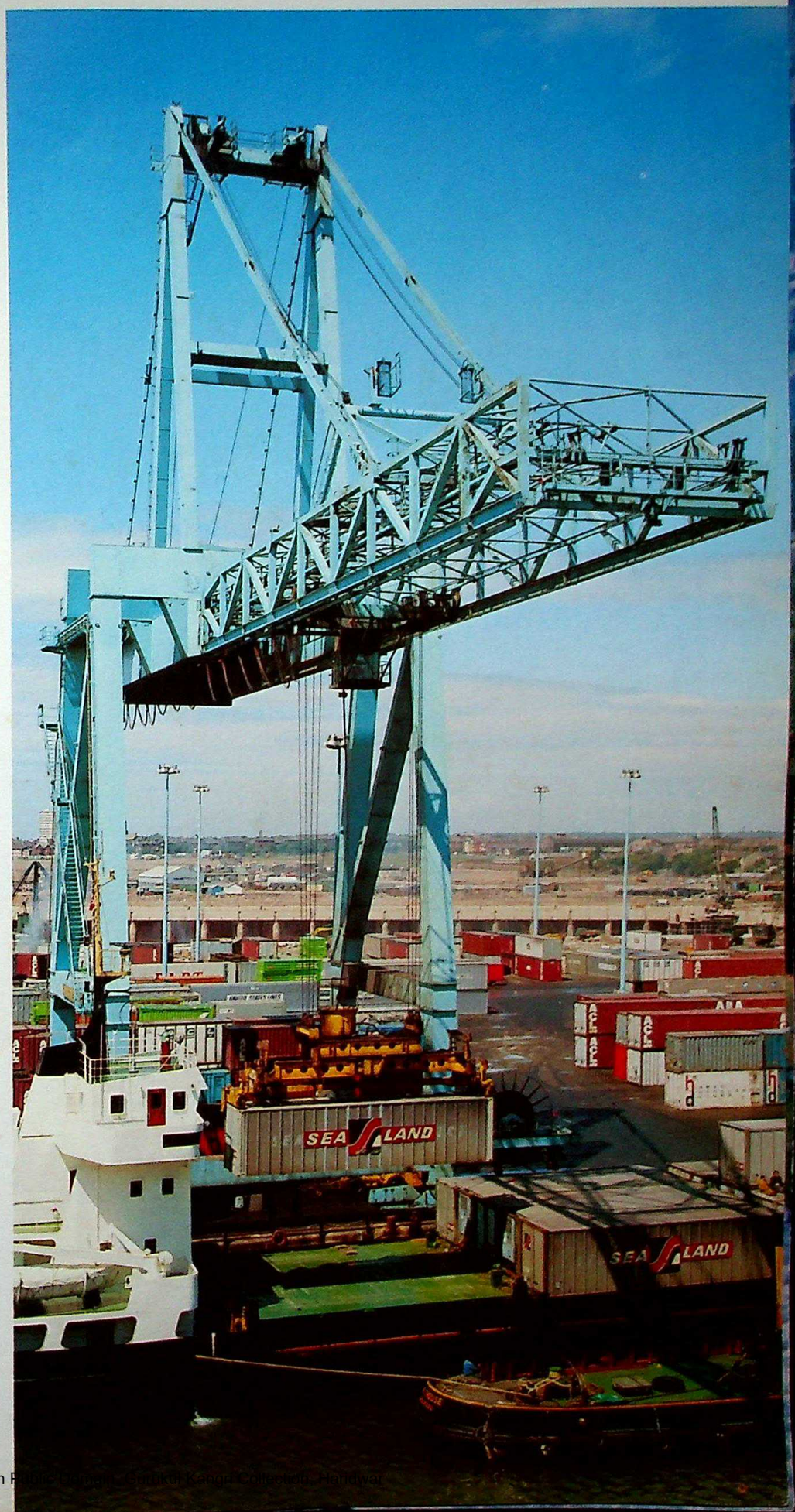
TRADE

There are few countries in the modern world which could exist by themselves. Most countries are lacking in one respect or another. They may not have the raw materials they need for their industries, or the necessary technical skills to develop industries. They may not be able to produce enough food to feed their population. So they make good their deficiencies by *trading* with other countries. They sell to other countries their raw materials, foodstuffs, manufactured products or skills. And with the money they earn, they buy the things they themselves need from other countries.

Apart from providing us with essentials, international trade enables us to have a greater *variety* of goods – tea from China, coffee from Brazil, silks from Japan, rugs from Persia, lamb from New Zealand, beef from Argentina, perfumes from France, wines from Germany, and so on. Our lives are made much richer because of our freedom of choice. The presence of markets overseas also enables us to produce goods on a larger scale, and therefore more cheaply than we otherwise could. Again, everybody benefits.

The goods a country sells to other countries are called *exports*, and the goods it buys from other countries are called *imports*. Ideally, a country wants to export more than it imports in order to make a trading profit. If exports exceed imports, the *balance of trade* is favourable, or is in *surplus*. If exports are less than imports, the balance of trade is unfavourable, or in *deficit*.

The goods a country exports, however, are sometimes only part of its exports – the *visible* part.



The container terminal at Liverpool. The packaging of goods in standard-sized containers has revolutionized cargo handling in recent years. The containers can be transported by lorry, railway or ship, being transferred from one to the other at specially built container terminals.

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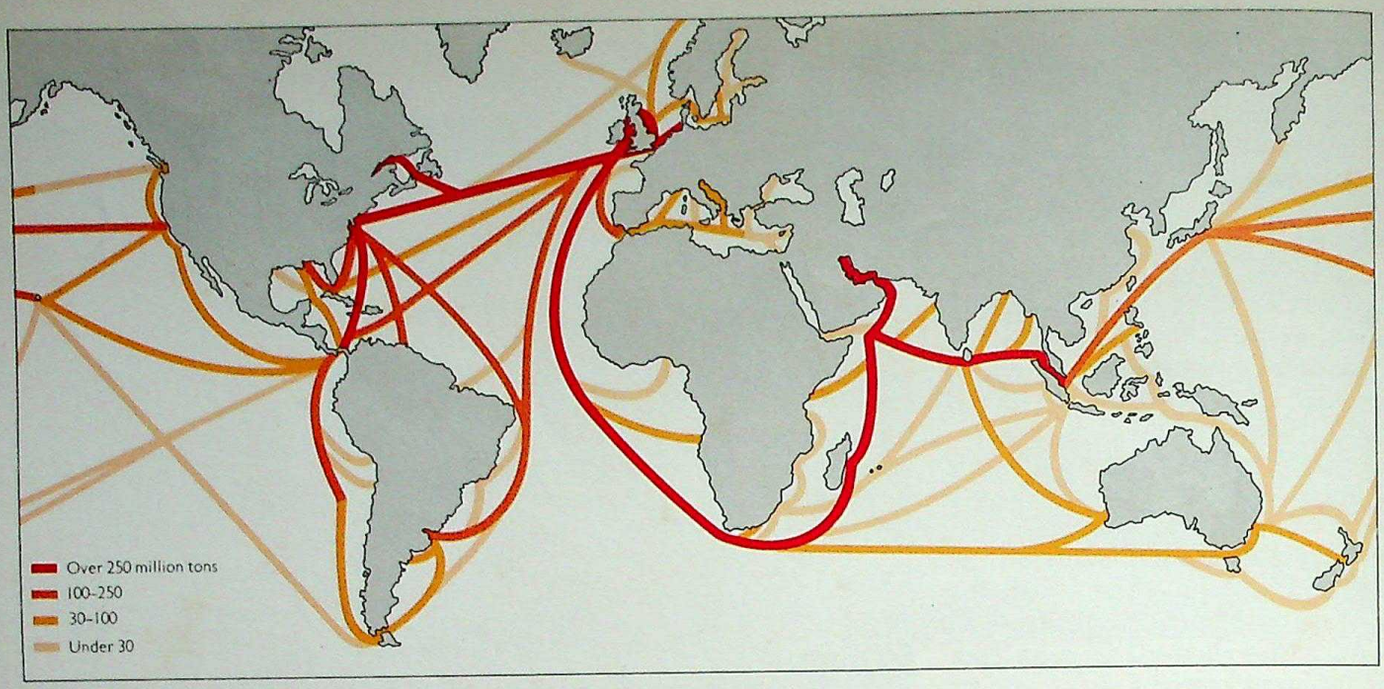


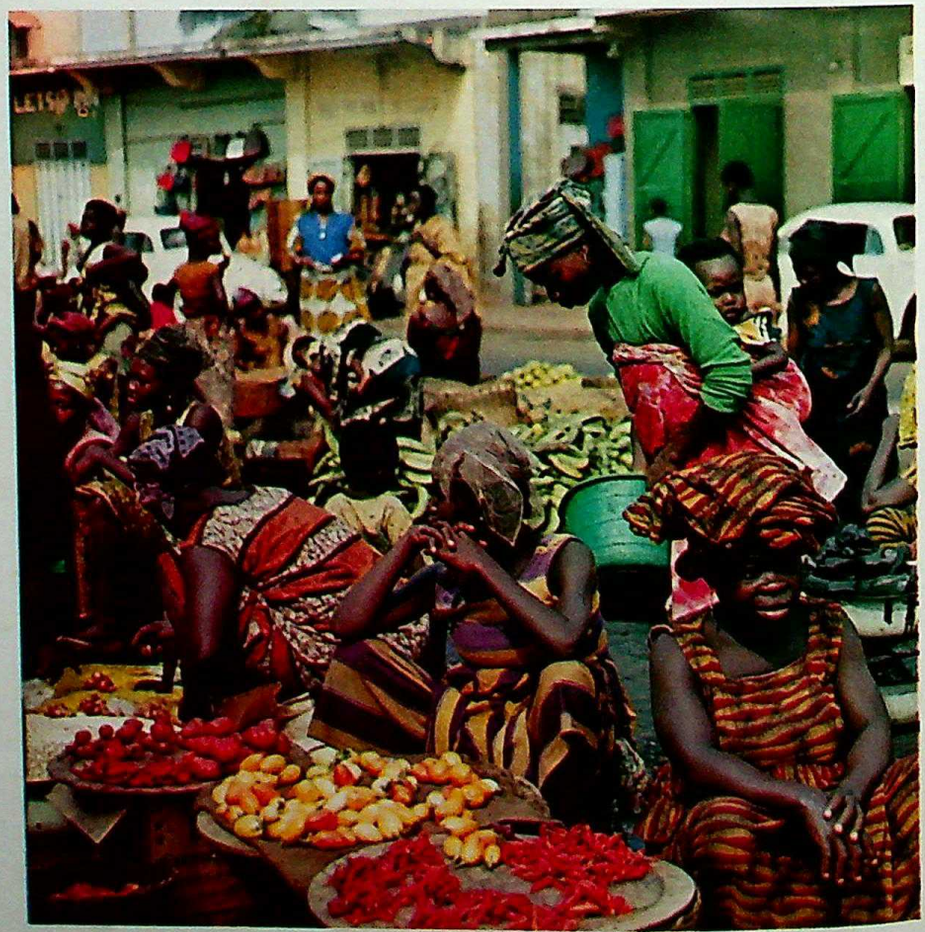
The other, *invisible* part includes the services the country provides to other countries. These services include shipping, banking and insurance. Invisible earnings can amount to more than a quarter of the total trade. They often have a marked effect on the balance of trade.

There are two basic kinds of imports or exports – primary products and industrial products. *Primary products* include raw materials and foodstuffs. *Industrial products* include manufactured goods of all kinds, from cameras and cars to textiles and tankers.

The world pattern of trade is quite clear. The highly developed countries of the Western world import primary products from the underdeveloped countries. They export manufactured goods to the rest of the world.

To improve trading, several countries may band together to form a *customs union* or a *free-trade area*. The idea is that barriers to trade between the countries are removed. Such barriers include taxes and restrictions on imports. A notable example of such a union is the *European Economic Community* (EEC), or Common Market. The EEC is made up of Belgium, Britain, Denmark, France, West Germany, Ireland, Italy, Luxembourg and the Netherlands. Western Europe's other trading group is the *European Free Trade Area* (EFTA), composed of Austria, Finland, Norway, Portugal, Sweden and Switzerland. A notable absentee from the trading groups is Spain. Most Eastern European countries are combined in a trading area called the *Council of Mutual Economic Aid*, or COMECON.

Above: The major shipping routes of the world. The busiest by far are those in the North Atlantic between Western Europe and North America. Below: Trading of a rather different kind takes place in this street market in Takoradi, a seaport town in south-west Ghana.



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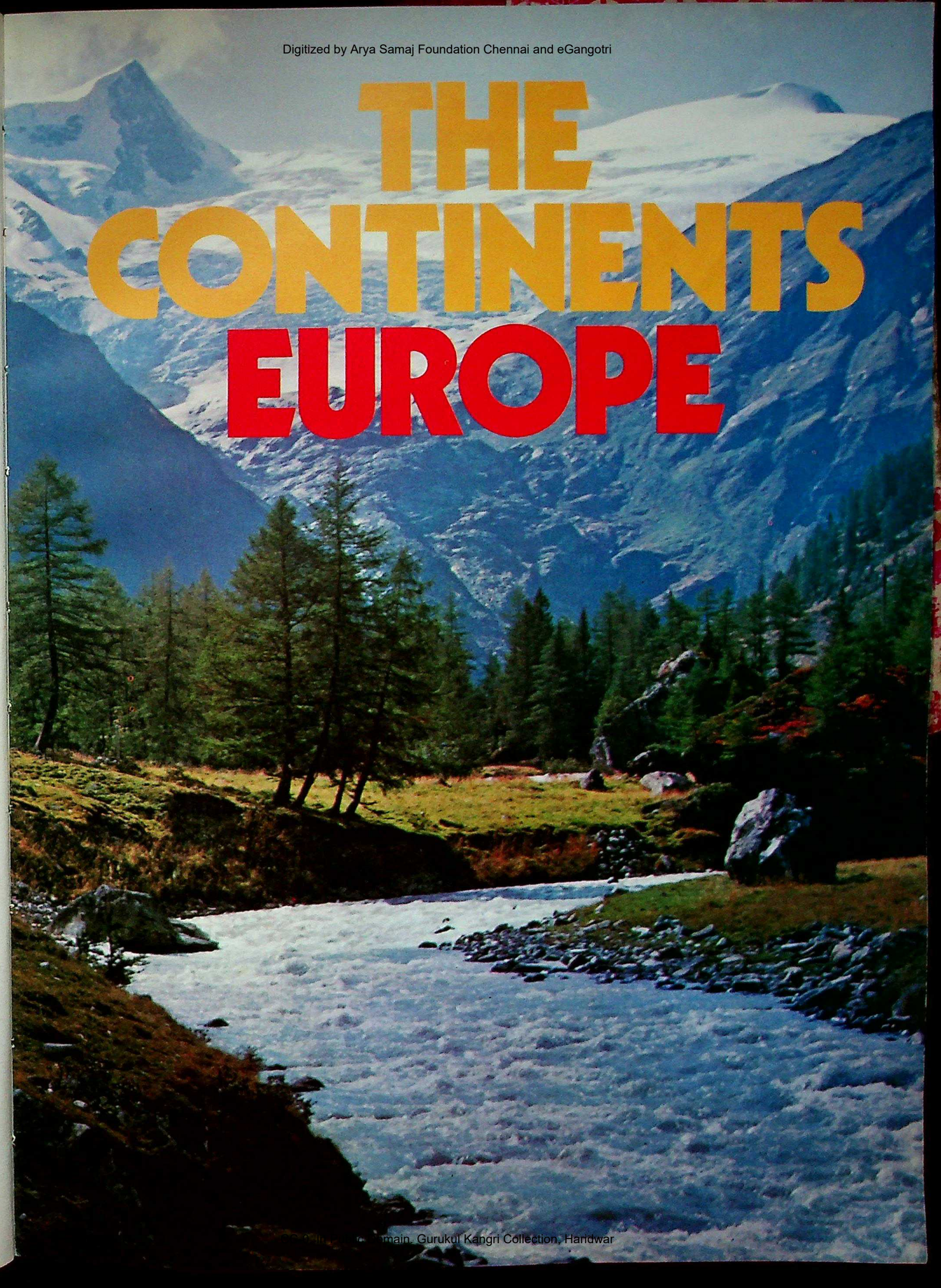
EUROPE



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INTRODUCTION

Europe is the sixth largest continent. Only Oceania, including Australia, is smaller. Europe covers a total area of 10,531,000 square kilometres (4,066,000 square miles). This is about one-fourteenth of the world's land area. But Europe is thickly populated. It has more than one-sixth of the world's population. Only Asia has more people. Despite setbacks caused by World War I (1914–1918) and World War II (1939–1945), Europe still leads the world in manufacturing and trade.

Europe has had a great influence on the world. Vast areas, such as Australia, Canada and the United States, are populated largely by people of European origin. European languages are important internationally. About four-fifths of the world's business is conducted in English, French or German. Other languages used over large areas include Italian, Portuguese, Spanish and Russian.

The spread of modern European influence began in the 1400s when Portugal and Spain began the Age of Exploration. Later, England and France, and then the Netherlands, Germany, Italy and Belgium also became involved in colonizing much of the world. The Europeans often treated non-Europeans harshly. For example, the Spanish, Portuguese, British and Dutch were involved in the cruel slave trade between 1550 and 1850.

However, Europeans also introduced new ideas of agriculture and technology. The Industrial Revolution began in Britain in the late 1700s and in western mainland Europe in the early 1800s. From Europe, knowledge of manufacturing techniques spread around the world.

Above: A village in the Aosta Mountains of northern Italy. These mountains form part of the Alps.
Right: A French truffle market. Truffles are small edible fungi, often smelt out by trained pigs.

Europe's Economy

Europe's economic strength is mainly derived from its manufacturing industries and its trade. In some countries very few people work in agriculture, and these countries have to import food. They pay for the imports by selling manufactured products or by obtaining money from banking, commerce, finance and shipping.

In the world as a whole, over half the people work on the land. But in Europe only one person in five earns his living by farming. The figure of course varies from country to country. In Britain less than three out of every 200 people work on farms. In Albania more than half of the people are farmers. Since the end of World War II the proportion of farm-workers in Europe has been steadily decreasing. This is particularly true of Eastern Europe, where manufacturing has expanded greatly.

Fishing is also an important industry in Europe, particularly in Iceland and Norway. The continent now produces about one-fifth of the world's total catch.

Farming: Because of its favourable climate and the use of scientific methods, a high percentage of Europe can be farmed. Only in the far north is the land infertile and the climate too cold. Much of the land in north-west and north-central Europe is devoted to cereals, such as barley, oats, rye and wheat. Flax, sugar beet and vegetables such as potatoes are also major crops. Cattle farming for beef and dairy products is of great importance. Sheep are raised mainly in hilly areas. In Russia and Eastern European countries cereals and sugar beet are also the chief crops.

In the warm climate of southern Europe maize and even rice (in irrigated areas) are cultivated, as well as barley and wheat. The Mediterranean lands also produce citrus fruits, dates, figs, grapes and olives. Because of the dry climate, most Mediterranean lands do not have such rich pasture, so cattle are less important. However, goats and sheep thrive in the area.

European farms vary greatly in size. In western Europe they are mostly small. But yields are high because scientific methods are used. In Russia and most of the

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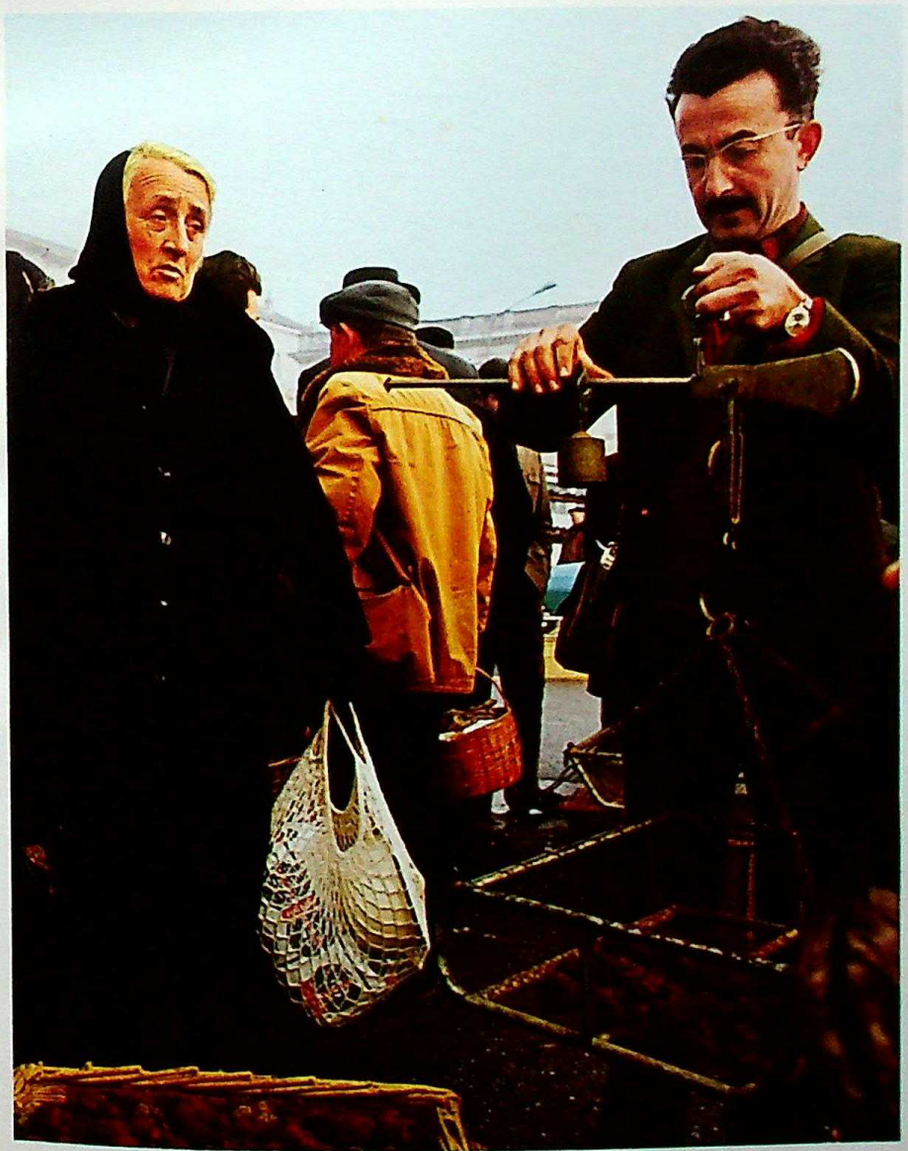
Eastern European countries, farmers share the produce on large *collectives* (co-operative farms), or they work for pay on big state farms.

Industry: Coal was the fuel on which European industry was based, and the continent still has massive coal reserves. Russia, West Germany and Britain are the chief producers. But coal mining has declined in recent years because of competition with petroleum. Most countries in Europe import petroleum. Russia, however, has abundant petroleum deposits of its own. Britain and Norway are beginning to exploit the vast North Sea petroleum fields. Europe also has large reserves of iron ore. But it lacks big deposits of many other metals, which have to be imported.

The chief industrial regions of Europe extend from Britain, across northern France, Belgium, West and East Germany, into Poland and Czechoslovakia. These regions are mainly based on coalfields. Coalfields in the Moscow, Ukraine and Ural regions of Russia were also sites of early industrial development. In recent years the use of hydroelectric power and petroleum has made it possible for countries to found industries away from coalfields.

Since 1948 industrial production has increased rapidly in several European countries, especially West Germany, Russia and most Eastern European countries. Of the world's top ten steel producers, eight come from Europe. They are Russia, West Germany, Britain, France, Belgium and Luxembourg (combined), Italy and Poland.



European industries vary greatly. Countries with large coal and iron-ore deposits have tended to produce heavy machinery. Countries with few resources, such as Switzerland, have concentrated on making products such as watches, which require great skill. Other industries process farm produce. For example, France leads the world in wine production.

The People of Europe

Most people in Europe belong to the Caucasoid group of the human race. There are broadly three types. The *Nordic* people of northern Europe are tall and fair-haired. They have long skulls, fair skins and blue eyes. In southern Europe, the *Mediterranean* people are also long-skulled and tall, but not as tall as the Nordics. They have dark hair, dark complexions and brown eyes.

Between these two groups, the *Alpine* people of central Europe are short and sturdy. Their skulls are broader than those of the Nordic and Mediterranean peoples, and they have medium to dark complexions. However, the peoples of Europe have been intermarrying for generations, and many people are a mixture of these racial types.

Languages and Religions

A simpler way of dividing the people of Europe is into language or religious groups. In Europe there are about 30 main languages and many dialects. Within some countries, there are several language groups, as in Belgium and Switzerland. Language differences have often caused conflict and provoked war. So have differences in religions.

Most European languages belong to one major language family, called the *Indo-European*. The original speakers of these languages ranged from western Europe to northern India. Languages which do not belong to the Indo-European group include Albanian, Basque (Spain), Finnish, Hungarian and Turkish.

In Europe the largest Indo-European language group is *Slavic*. The Northern Slavs include

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the Czechs, Poles and Slovaks. The Southern Slavs include the Bulgarians, and the Macedonians, Serbo-Croats and Slovenes who live in Yugoslavia. Russians form a third Slav group.

The second most important group of Indo-European languages is the *Germanic*. This group includes Danish, Dutch, German, Norwegian and Swedish. Basically, English is a Germanic language, but it has been greatly influenced by the classical languages, Greek and Latin, and also by French.

Languages derived from Latin are called *Romance* languages. They include Catalan (in Spain), French, Italian, Portuguese, Romanian and Spanish. Romanian, however, has been influenced by Slav languages. Another quite small Indo-European group – *Celtic* – includes Breton (Brittany, France), Erse (Ireland), Gaelic (Scotland) and Welsh.

Most Europeans are Christians. They follow the teachings of the Roman Catholic, Orthodox and Protestant churches. There are also some Jews and, in south-eastern Europe, some Muslims. The Jewish population was greatly reduced under Nazi rule during World War II. After the war, many Jewish survivors went to live in the new state of Israel.

Europe after World War II

In 1945 Europe faced many problems. For the second time in the century, the continent had been devastated by a terrible world war. Millions of people had died, and formerly rich nations had used up much of their wealth in fighting the wars.

By the late 1940s, Europe was also divided politically into communist and non-communist groups. The communist countries occupied two-thirds of Europe's area. But the non-communist countries had a powerful ally in the United States. In 1949 the United States and several west European countries set up the military alliance called NATO as a protection against possible communist aggression. NATO stands for the *North Atlantic Treaty Organization*. The communist countries later set up their own military alliance, the *Warsaw Treaty Organization*.

Another problem for several European countries occurred as people in European colonies around the world began to demand independence. And as time went on Belgium, Britain, France, the Netherlands, Portugal and Spain steadily lost their overseas possessions.

THE COUNTRIES OF EUROPE

Country	Area Sq. Km.	Population 1975 est.	Capital
Albania	28,748	2,500,000	Tirana
Andorra	453	14,000	Andorra la Vella
Austria	83,849	7,611,000	Vienna
Belgium	30,513	9,835,000	Brussels
Bulgaria	110,912	8,705,000	Sofia
Czechoslovakia	127,869	14,753,000	Prague
Denmark*	44,468	5,140,000	Copenhagen
Finland	337,009	4,693,000	Helsinki
France	547,026	53,074,000	Paris
Germany (East)	108,178	16,902,000	Berlin (East)
Germany (West)	248,577	62,838,000	Bonn
Gibraltar	6	27,000	—
Greece	131,944	8,793,000	Athens
Hungary	93,030	10,453,000	Budapest
Iceland	103,000	218,000	Reykjavik
Ireland, Republic of	70,283	3,084,000	Dublin
Italy	301,225	55,770,000	Rome
Liechtenstein	157	22,000	Vaduz
Luxembourg	2,586	358,000	Luxembourg
Malta	316	319,000	Valletta
Man, Isle of	588	61,000	Douglas
Monaco	1	26,000	Monaco
Netherlands	40,844	13,708,000	Amsterdam
Norway	324,219	4,017,000	Oslo
Poland	312,677	33,964,000	Warsaw
Portugal	92,082	8,496,000	Lisbon
Romania	237,500	21,205,000	Bucharest
Russia (in Europe)	5,571,000	189,703,000	Moscow
San Marino	61	19,000	San Marino
Spain	504,782	35,628,000	Madrid
Svalbard and Jan Mayen Is.	62,422	—	—
Sweden	449,964	8,202,000	Stockholm
Switzerland	41,288	6,603,000	Bern
Turkey (in Europe)	23,623	2,981,000	Ankara
United Kingdom†	244,241	56,493,000	London
Vatican City	0.44	1,000	—
Yugoslavia	255,804	21,377,000	Belgrade

*Inc. the Faroe Is.
†Inc. the Channel Is.

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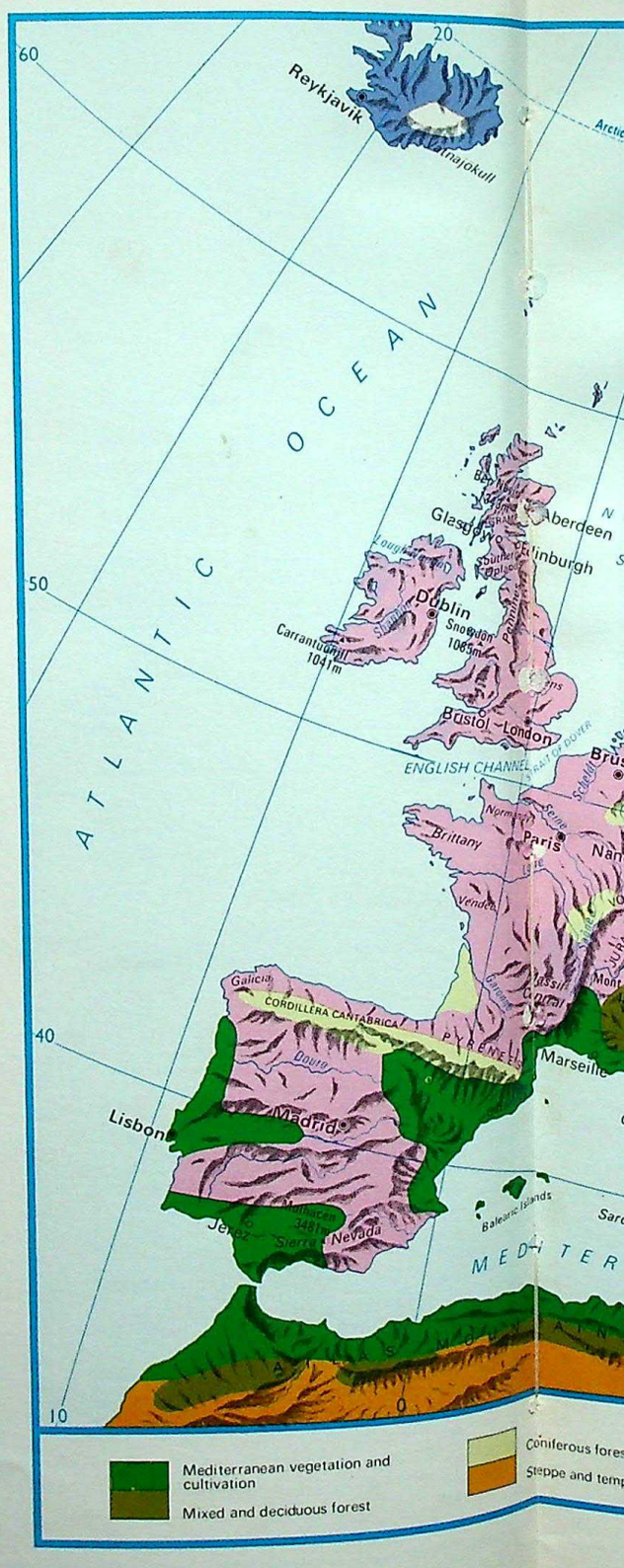
A shepherd tending his sheep in France's Southern Alps.

Against this uneasy background, Europe began to rebuild. Rapid progress was achieved by co-operation. Italy, Germany, Belgium, France, Luxembourg and the Netherlands formed the European Coal and Steel Community, and pooled their coal and iron-ore resources.

THE FLAGS OF EUROPE



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Economic Alliances

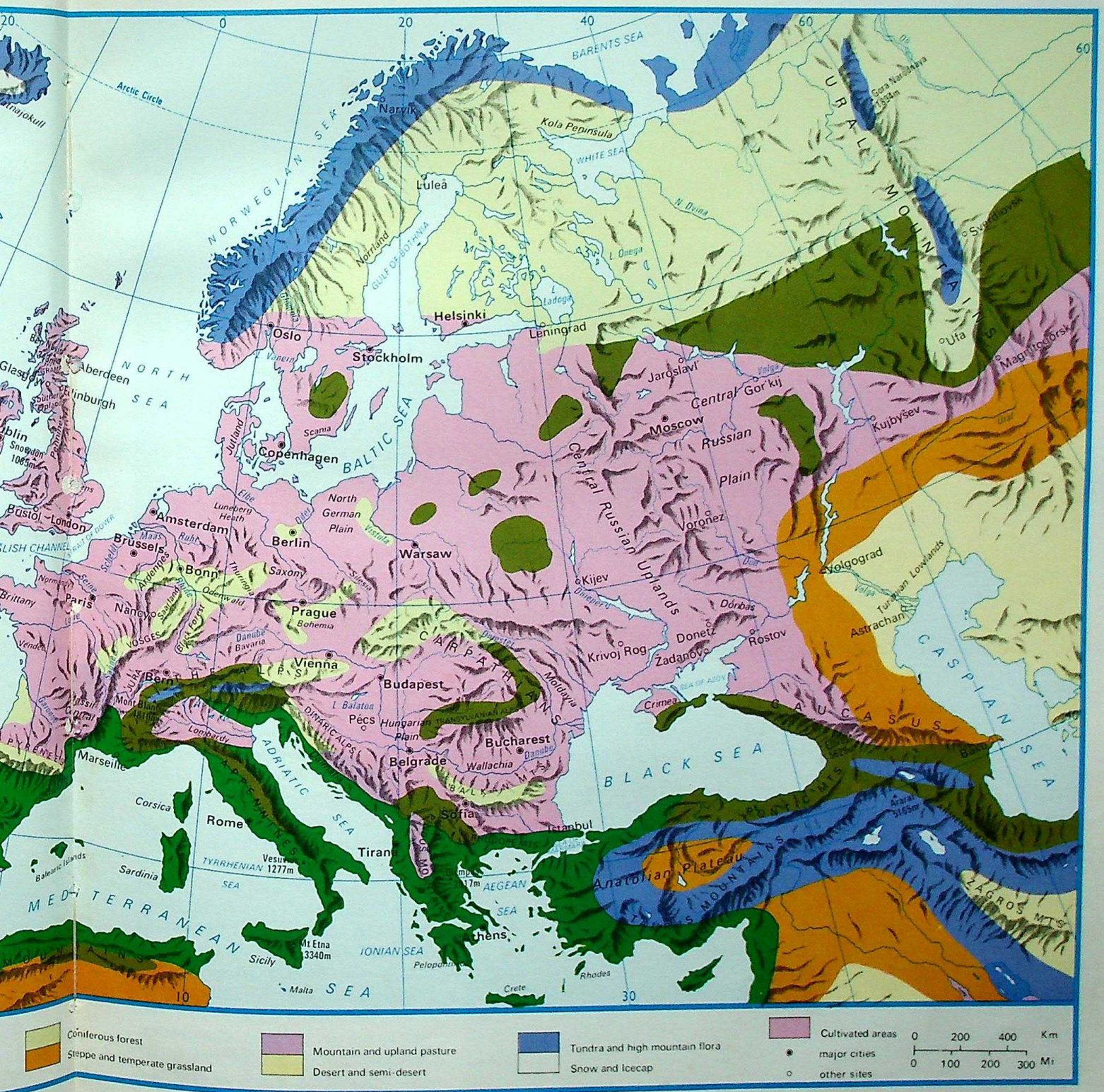
The six countries soon decided to go even further. In 1958 they set up the *European Economic Community* (EEC), also called the *European Common Market.*

In 1960 another group of nations – Austria, Britain, Denmark, Norway, Portugal, Sweden and Switzerland – set up the *European Free Trade Area* (EFTA). But EFTA proved less successful than the EEC. In January 1973, Britain, Denmark and the Republic of Ireland joined the EEC.

In Eastern Europe an economic community called COMECON came into being in 1949. COMECON stands for the *Council of Mutual Economic Aid.*

Through these economic alliances, most European countries made a rapid recovery after World War II. However, in the 1970s Europe was affected by a problem that was sweeping the world – galloping inflation.

Rather ironically, West ermany, who had been defeated in two world wars, had the strongest economy and a low inflation rate (of about 5 per cent). Britain, victorious in the two world wars, had one of the weakest economies, with a high inflation rate.



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CLIMATE & NATURAL REGIONS

In the far northern part of Europe is the bleak, featureless region known as the tundra. Mosses and lichens are the main vegetation.

Climate

The climate is without doubt one of the main reasons why Europe has been so important in world history. The generally temperate climate, which is neither too hot nor too cold, is healthy. It encourages people to work hard and to take initiatives.

Europe stands at the end of a super-continent which also includes Asia. This super-continent is called *Eurasia*. Europe is bounded at the west by the North Atlantic Ocean. Its eastern border, in Russia, runs through the Ural Mountains and down to the Caspian Sea. Europe's western coastline is deeply indented by the sea. In the north the Atlantic Ocean is connected with the nearly landlocked Baltic Sea. In the south is the Mediterranean Sea, which extends eastwards from the Atlantic. It is linked to the Black Sea through the Dardanelles Strait, the Sea of Marmara and the Bosphorus. The Caucasus Mountains extend from the Black Sea to the Caspian Sea to complete Europe's southern boundary.

The sea greatly affects the climate of Europe. The waters of the Atlantic Ocean off western Europe are part of a current called the *North Atlantic Drift*. This is an extension of the warm Gulf Stream. The warm Atlantic waters are especially effective in winter. The westerly winds that blow over the water onto the land are warmed, bringing mild conditions to the western coasts. However, the influence of the sea is felt less and less as you travel eastwards. Winter temperatures gradually fall, and summer temperatures slowly increase.

If you travel from south-west Ireland through Berlin into European Russia on more or less the

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same line of latitude, the climate gradually becomes more extreme, or *continental*. In south-west Ireland the highest summer temperatures average only about 15°C (59°F), and the lowest winter temperatures, about 7°C (40°F). The temperature range is only 8°C (14°F). In Berlin summer temperatures average 18°C (65°F), and winter temperatures average 0°C (32°F). The range is 18°C (33°F). In the same latitude, south of Moscow, summer temperatures average 21°C (69°F), and winter temperatures average −11°C (12°F). The range is 32°C (59°F). This is four times the temperature range in south-west Ireland.

Temperatures also increase from north to south. There are four main temperature regions. The north-west has mild winters and cool summers. The south-west has mild winters and hot summers. The north-east has cold winters and cool summers. The south-east has cold winters and hot summers. Rainfall is greatest in the north-west, especially in highland areas. In places the annual rainfall totals 5,000 millimetres (200 inches). It decreases to the south-east. In the Caspian Sea lowlands less than 250 mm (10 inches) falls every year.

Europe's weather is affected by air masses of different pressures. For example, *depressions* (low-pressure air masses) bring rain to western Europe. In winter, central and eastern Europe are cold, and air pressures are high. Air masses move from the interior, which remains dry. The interior gets most of its moderate rainfall in summer. In Mediterranean lands, on the other hand, summers are hot and dry. A little rain falls in winter.

Physical Features

The physical features of Europe also affect its climate. The highlands in general are wetter than the lowlands. Europe has three main physical regions. The mostly ancient northern mountains include Iceland, north-west Britain, Scandinavia, and the Urals, in Russia. These mountains have been worn down by glaciers and ice sheets. To the south are the central lowlands. They stretch from south-east England, through northern France, Belgium, the Netherlands, Denmark and southern Sweden, across Germany and Poland, and into Russia.

The southern mountains include the *Alpine system*. These recent folded ranges include the Cantabrian Mountains in Spain, the Pyrenees, the Alps, the Carpathians, the Balkan Mountains and the Caucasus range. These fold mountains were squeezed up between colliding blocks, or *plates*, of the Earth's crust (see page 58). Scientists believe that Italy was once separated from Europe. But the plate carrying Italy gradually moved towards Europe, and forced the sediments in between into great folds – the Alps.

Branches of the Alpine system include the Atlas Mountains in North Africa, the Sierra Nevada in southern Spain, the Apennines in Italy, and the mountains of Yugoslavia, Greece and the Greek islands. Volcanoes and earthquakes still occur in Alpine mountain regions. This suggests that the continents are still moving.

Other highland areas in southern Europe are lower and older than the Alpine system. They include the Spanish plateau, the central plateau of France, the Rhine highlands, the Bohemian plateau and the Rhodope Mountains. These highlands are fractured in many places. Some blocks have been uplifted. Others have sunk down between fractures, as in the Rhine Rift Valley. These fractures also were probably caused by pressures exerted by continental drift.

The rivers in Europe are in general much shorter than those in Asia, Africa and the Americas. Out of the 18 rivers in the world with a length greater than 3,000 km (1,865 miles), only one is in Europe. It is the *Volga* (3,690 km, 2,290 miles), in Russia, which drains into the Caspian Sea. The next longest river is the *Danube* (2,780 km, 1,730 miles), which flows through Germany, Austria,

The village of Monterchi, in Tuscany, is typical of many in this rolling, hilly region.

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Hungary, Yugoslavia and Romania to the Black Sea. The *Rhine* is very much shorter (about 1,130 km, 700 miles); but it provides one of the most important means of communications in Europe. It is linked to other rivers – including the Rhône, Marne, Danube, Weser, Elbe and Oder – by canal.

Natural Regions and Vegetation

Europe has five main natural regions. They are the northern tundra, the north-west coastlands, central Europe, the Mediterranean region, and the steppe-lands.

The northern tundra is a bleak, treeless region, with a short summer and a long winter. Rainfall is very light, and the chief plants are mosses and lichens. Stunted bushes grow in hollows, and colourful flowers brighten south-facing slopes in summer.

The north-west coastlands include the British Isles, northern Spain, western France, Belgium, the Netherlands, Denmark and the west coast of Norway. This region has rain all the year round. Winters are mild and summers cool. The original vegetation of this region was deciduous forest, such as oaks, on the low ground, with conifers on the high ground. But most of the trees have been cut down to provide farmland.

The cool interior of Europe consists of the north-west Baltic region, continental Russia north of the steppe-lands, and central Europe. The Baltic Sea region has very cold winters, and the Baltic Sea freezes over for part of the time. The summers are short, but warm. The region is heavily forested with conifers. They provide valuable softwoods, which are used in the timber, wood-pulp and paper industries.

The Baltic region is a kind of half-way house between the mild north-western coastlands and continental Russia. In continental Russia winters are extremely cold, summers are hot, and the rainfall is light. The northern part of continental Russia contains coniferous forests. In the south the original deciduous forest has been cut down, and the area is now largely farmland. Central Europe is also a transition region, but it has warmer summers than the Baltic region.

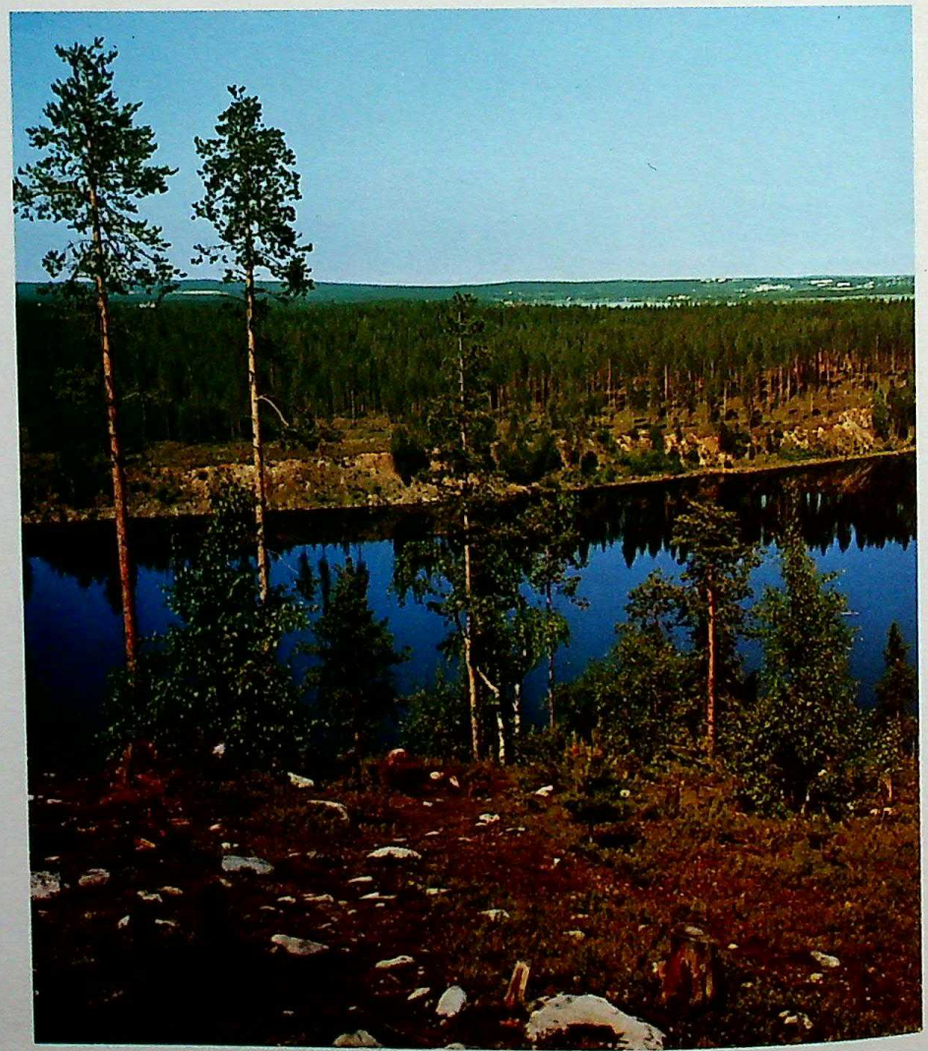
The Mediterranean region has mild, moist winters and hot, dry summers, which attract millions of tourists from northern Europe. The vegetation is largely *maquis*, a kind of low scrub. The native plants are mainly evergreens, which can survive the summer drought. The trees include cedars, cork oaks, cypresses, laurels, myrtles and olives.

The steppe-lands of south-east Russia and parts of Romania are largely treeless, because there is not enough rainfall. Trees grow only along the river banks. However, the grassy steppe-lands have rich soil and make excellent farmland. In the south-east the steppe becomes increasingly dry. A semi-desert covers the lowlands around the Caspian Sea, which lies below sea level.

Wildlife

As the population of Europe increased, the larger animals, including bears, wild boars, stags and wolves, were driven into isolated forest regions. They still survive there today, though in much smaller numbers than before. Some native animals, such as the huge European bison, survive only in reserves. Many of Europe's small animals are still hunted. They include the fur-bearing animals of northern Europe, such as beaver and ermine.

Many Europeans today are concerned with conservation – protecting the animals that remain and their habitats. Birds and fish are especially in danger because of *pollution*, caused, for example, by industry and by the use of chemicals in modern farming.



This forested region in northern Finland forms part of a vast forest belt extending across Eurasia.

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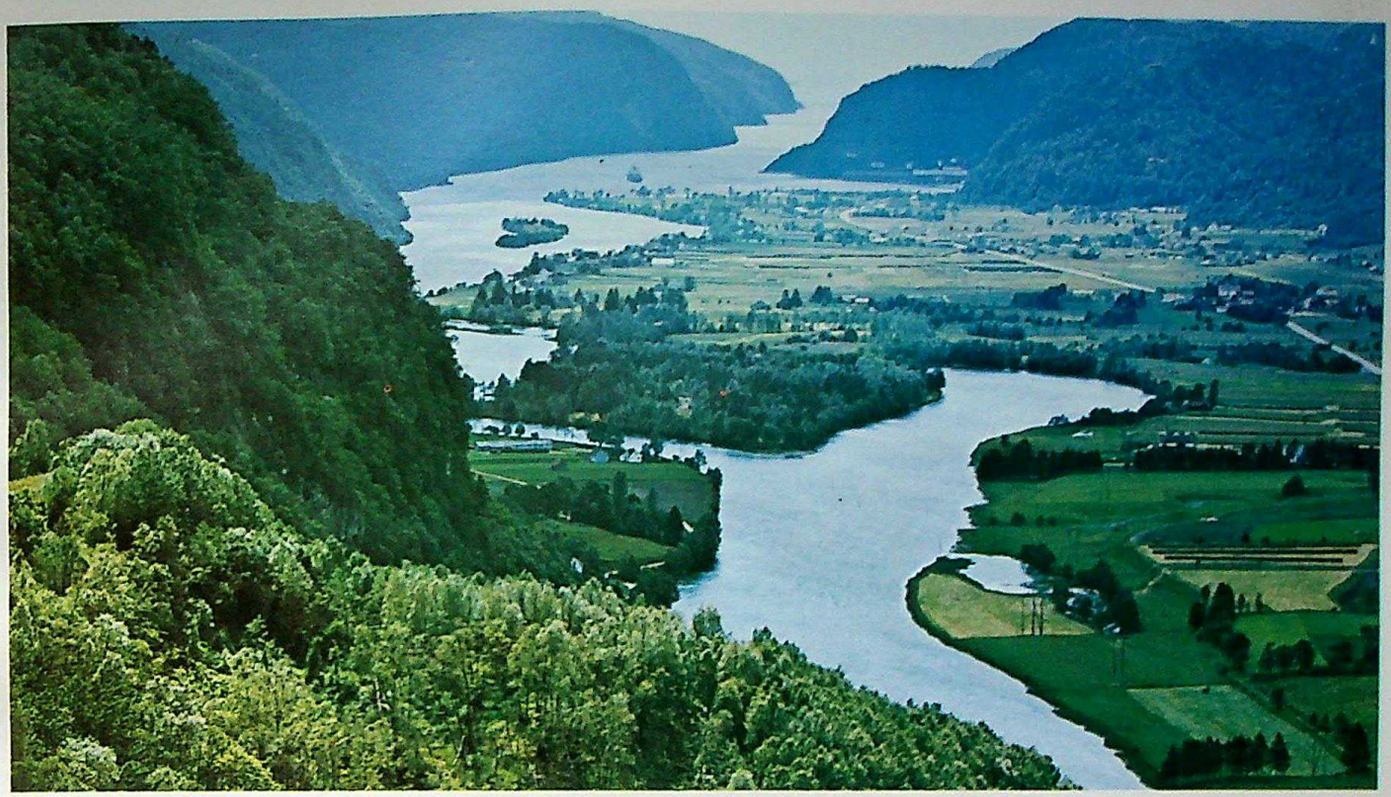
NORTHERN EUROPE



Northern Europe consists of five countries. Norway and Sweden occupy the Scandinavian peninsula. Finland lies on the eastern side of the Baltic Sea. Denmark is the southernmost country. Iceland is a large island in the Atlantic Ocean, but it is regarded as part of northern Europe.

Norway

Norway is a large but thinly-populated country on the western side of the Scandinavian peninsula. About three-quarters of the country is unproductive. Timber forests cover much of the remainder. Less than one-twentieth of the land is cultivated.

The coastline of Norway has many offshore islands and is deeply indented by long sea inlets called *fiords*. In fact, if you straightened out Norway's coastline, it would extend half-way around the Equator! The fiords were gouged out by glaciers and they have steep sides. These deep valleys were flooded by the sea when the ice melted at the end of the Ice Age. Many coastal and island Norwegians are fishermen, and fishing is a vital industry. The chief fish caught are cod and herring. Norwegian fishermen also travel to the Antarctic to catch whales. The chief fishing port is Bergen (population 215,000), Norway's second largest city. Norway possesses the world's third largest shipping fleet.

Above: The beautiful Feda Fiord, one of Norway's famous fiords, or narrow inlets to the sea.
Below: One of the distinctive Norwegian stave churches, which dates back to the 11th century.

Some Norwegians work in forestry, which provides the raw materials for the important timber and wood-pulp industries. Farming is carried on around the coast, which has a mild climate. The coast is warmed by winds that blow over the North Atlantic Drift, an extension of the warm Gulf Stream. As a result, the coast never gets ice-bound. The northern port of Narvik lies well inside the Arctic Circle, but it remains ice free. In winter iron ore from northern Sweden is shipped from Narvik instead of the Swedish port of Luleå. Luleå, on the Baltic Sea, lies much farther south than Narvik but it becomes blocked by ice in winter.

The interior of Norway is mountainous, rising to bleak plateaux of more than 2,440 metres (8,000 feet) above sea level. The only lowlands lie in the south around the capital Oslo (469,000) and the

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nearby Glomma River valley. These lowlands are the most developed part of Norway. Such crops as cereals, potatoes, and hay for dairy cattle are grown.

Hydroelectricity is the main source of power, because Norway has many short, swift-flowing rivers. Industries include the pulp and paper industry, metal smelting and canning. However, Norway now possesses rich petroleum fields in the North Sea. It will soon be producing 10 times more petroleum than it needs. The income from petroleum has already begun to benefit the country's economy.

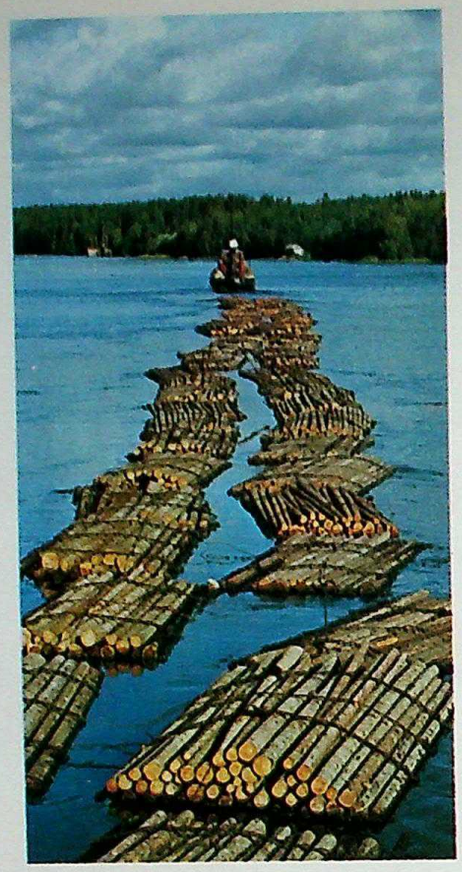
Sweden

Sweden has much more lowland than Norway. It also has large mineral resources, particularly iron ore. Its timber reserves are also greater than Norway's. More than three-quarters of all Swedes live in towns, where manufacturing is important.

In the extreme north of Sweden, and also in Norway, Finland and the USSR, there is a region called Lapland, where a few people called Lapps live. The Lapps' way of life depends on reindeer. They eat reindeer meat, use reindeer to pull their sledges, and use reindeer skins to make clothes and tents.

More than half of the country consists of the thinly-populated northern Norrland region. This region contains great coniferous forests, and the timber industry is extremely important. There are also immense deposits of iron ore around the Norrland towns of Gällivare and Kiruna. In summer the iron ore is exported through the Baltic Sea port of Luleå.

South of Norrland lies the lake depression of Sweden. This region contains several large lakes, including Mälaren, Vänern and Vättern. The climate of this region is reasonably mild, and the area produces cereals and potatoes. There are also important mineral deposits. Industrial centres include Göteborg (449,000), on the western coast, and Norrköping (120,000) and Stockholm (681,000) on the eastern coast. Stockholm is the country's beautiful capital. Because Göteborg is ice-free all the year round, it is Sweden's leading port.



Above: Timber is Finland's main natural resource, and the timber industry is vital to the country's economy. Finland's many rivers and lakes provide a ready means for transporting the logs.
Below: A Lapp in traditional costume. The Lapps are nomadic herdsmen of northern Scandinavia who raise reindeer, and follow the herds from their summer pastures in the mountains to the lowlands in the winter.

South of the lake region is an infertile plateau. This gives way at the southernmost tip of the country to a rich agricultural area, Scania. Scania produces wheat and other cereals, hay, sugar beet and dairy products. The area's chief town and port is Malmö (251,000), Sweden's third largest city.

The people of Sweden enjoy a high standard of living. Their prosperity is based mainly on mining and manufacturing, especially metal products, machinery and transport equipment. Although Sweden has little coal, there is plenty of hydroelectric power.

Finland

Finland lies on the eastern side of the Baltic Sea. Lakes cover nearly one-tenth of the country. These lakes occupy rocky basins in a low-lying plateau in central and southern Finland. The basins were scooped out by ice sheets. Finland has as many as 35,000 lakes, and other large areas are boggy or marshy.

Winters in Finland are very cold. The capital Helsinki (845,000), in the extreme south, is covered by snow for about 120 days every year. The chief occupations are farming and forestry. Farmland covers about one-tenth

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The edge of the vast Vatnajökull glacier in Iceland, which is the largest glacier in Europe.

of Finland, mainly in the flat south-west region. Cereals, potatoes and food for livestock are grown.

Forests cover about two-thirds of the country. Finland exports wood-pulp and timber products. With hydroelectric power, it has developed papermaking and printing industries. The country also has some metals, including copper and iron, and machinery and transport equipment are manufactured.

Denmark

Denmark is a densely populated country, which consists of the Jutland peninsula and a group of islands. The largest island is Sjaelland (Zealand), which contains Denmark's capital Copenhagen (København; 802,000). The other main island is Fyn (Funen), whose main town is Odense. The country is low-lying. Although some areas are infertile, two-thirds of the country is productive farmland. Denmark has a long tradition of very efficient, co-operative farming, mainly of livestock. Its exports of bacon, butter, cheese and eggs are well-known, especially to the industrial populations of West Germany and Britain.

About three out of every ten Danes work in manufacturing and handicrafts. The traditional food-processing industries still produce the most valuable group of goods. But Denmark now has other industries. They are based on imported raw materials, because the country lacks large mineral deposits of its own. Denmark has engineering industries, producing machinery, metal goods, and ships and vehicles, as well as chemical and textile industries. The chief industrial cities are Copenhagen and Aarhus (199,000).

Iceland

Iceland is a largely barren land. There is much volcanic activity, and the central highland region consists of vast lava fields. Much of the rest of the country consists of a bare plateau averaging about 760 metres (2,500 feet) above sea level. There are several large glaciers in the highlands. The largest is Vatnajökull, in the south-east. Covering some 8,400 square kilometres (3,240 square miles), it is the largest glacier in Europe.

Iceland is also noted for its spectacular waterfalls, hot springs and geysers. The word 'geyser' in fact comes from the Great Geysir, in the south-west of the country. Water from hot springs is used to heat homes in the capital Reykjavik (84,000). Iceland lies on the Mid-Atlantic ridge. New volcanic rock is continually being added to the island, making it wider. This provides evidence for the theory of plates. (See page 58.)

Only one part in 200 of Iceland is cultivated. The main crops include hay, potatoes and turnips. Livestock, especially sheep, are also raised. Many Icelanders are fishermen. In the early 1970s Iceland had about 900 fishing vessels, and the average annual catch amounted to more than four tonnes per head of the population. Fish and whale products are by far the most important exports, and canning is one of the most important industries. In 1975 the Icelanders tried to extend their fishing limits to 320 km (200 miles), which led to international disputes.

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THE LOW COUNTRIES

The so-called Low Countries consist of the Netherlands (Holland), Luxembourg and Belgium. They are also called the *Benelux* countries. The Benelux customs union between these three countries came into existence in 1948. Through this union, trade between the countries increased rapidly, and a full economic union was created in 1960. These three countries not only co-operate together. They are also founder members of the European Economic Community (EEC).

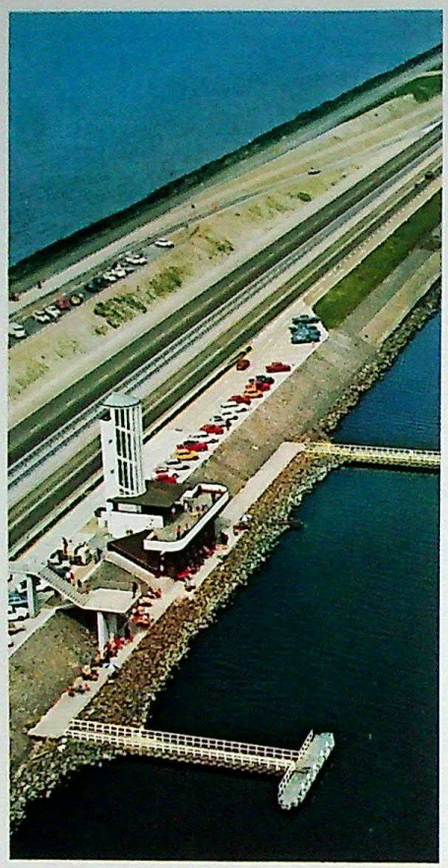
The Low Countries are small, but thickly-populated nations whose people enjoy a high standard of living. Both the Netherlands and Belgium once had large overseas empires, and they became prosperous trading centres. They still are. They are also highly industrialized.

The Netherlands

The Netherlands is a flat but attractive country. The land is criss-crossed by a network of canals dividing up the small farms. The towns are mostly old and picturesque. Windmills are still a familiar feature of the landscape. They power the pumps used to drain water from the land.

Farmland covers more than six-tenths of the country's land area. Nearly two-thirds is grassland, and livestock are very important. With Belgium, the Netherlands has more cattle per square kilometre than any other country. Dairy farming for butter and cheese and poultry farming for eggs are especially important. The chief crops include flowers and bulbs, potatoes, sugar beet, wheat and other cereals. Manufacturing industries now employ about four out of every ten working people. The country has abundant power resources, following the discovery of vast deposits of natural gas near Groningen and under the North Sea. Imports of petroleum have led to a recent growth of petrochemical industries.

Two-fifths of the Netherlands lies below the high-tide level of the sea. For hundreds of years the Netherlanders, or Dutch, have struggled to enlarge their country seawards. They build walls called *dykes* around land they want to reclaim from the sea forming what is called a *polder*. Then they drain it, and turn it into fertile farmland.



Part of the 30-km dyke, built by the Dutch to cut off the former Zuider Zee from the North Sea.

The people have over the years suffered many setbacks in their reclamation schemes. The most recent occurred early in 1953. A severe storm in the North Sea combined with high tides to create tremendous waves. These waves battered and finally breached the dykes. Seawater swept over the land. Some 1,250 square kilometres (480 square miles) of land was flooded. About 1,800 people were drowned, and large numbers of livestock perished. The damage was estimated at £100 million.

But the Dutch quickly repaired the damage, and also began new plans for land reclamation. Their so-called Delta Plan involves building dykes between the islands in the south-west and stopping the sea from entering the delta. Only the Scheldt estuary will be left open.

The Netherlands consists mainly of a vast delta formed by rivers, including the Maas, Rhine and Scheldt. The country has three main land regions: the coastal belt, the polders and the eastern Netherlands. The coast and the islands are mostly bordered by infertile sand dunes. Many of these dunes have been strengthened to stop the sea breaking through.

The polder lands cover four-tenths of the country. They form the richest farming areas. There are three main regions. In the north-east the polders of Groningen province contain lush pasture for dairy cattle. In the south-west the Zeeland, or 'island', region produces livestock and crops. The central polder region is the most important of all. In addition to livestock farming, it produces large crops of bulbs, flax, flowers, potatoes, sugar beet and wheat. The largest recent drainage scheme has been in the former Zuider Zee, which was a deep inlet of the sea. This area has been largely reclaimed. The freshwater lake remaining is called IJsselmeer.

The Netherlands' chief cities are in the polder region. They include the capital Amsterdam (population 1,002,000), which is a great commercial city. Rotterdam (1,040,000) is the country's chief port. It also handles much traffic for West Germany. Near the coast The Hague (685,000) is the seat of the Netherlands government and also the seat of the International Court of Justice. Amsterdam, Rotterdam and other towns have varied industries. Some are based on processing materials produced in the country. Such industries make beer, cheese, linen and sugar. Other industries use imported materials and produce such things as chocolate, cocoa and tobacco.

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The eastern Netherlands is slightly higher. It is largely covered by deposits laid down by the ice sheets at the end of the Ice Age. There are boggy areas, some of which have been drained, fertilized and made into good farmland. In the south-east some coal is mined, but its importance is declining.

Belgium

Belgium consists largely of a broad plain. Unlike the Netherlands, however, it contains a highland area in the south-east. The coastline is about 64 kilometres (40 miles) long. Along the coast there are several seaside resorts, such as Ostend, and ports which serve the ancient inland towns of northern Belgium, or Flanders. These Flemish towns are renowned for their linen and woollen goods. Their delicate lace is world-famous. They include Bruges (population 120,000) and Ghent (144,000). Behind the sandy coast is a strip of reclaimed land, which is intensively cultivated.

Inland from the coastal strip is the broad Central Plain, drained by the River Scheldt and its tributaries. The Scheldt Basin is the chief farming region of Belgium. Among the crops grown are wheat, rye and other cereals, sugar beet and potatoes. The Scheldt flows northwards, and Belgium's chief port, Antwerp (217,000), lies near its mouth. Canals connect Antwerp to the capital Brussels (1,063,000) and to Liège (143,000). Brussels, like Paris, is known for its luxury products, but it has many other industries. Liège has engineering, metal-working and chemical industries. Antwerp is also connected to the newer industrial area in the north-east in the region called the *Campine*. The Campine has rich coalfields which produce most of Belgium's coal.

South of the Central Plain lies the industrial region of the Sambre-Meuse (Maas) valley. This was formerly Belgium's chief industrial area. It was based on coalfields which occur from Mons in the west, through Namur, to Liège. This region has declined in recent years, because the coal is expensive to mine, and cannot compete with cheaper West German coal.

Above: The picturesque town of Esch-sur-Sûre, in Luxembourg. Below: Bruges, in Belgium, a city of canals and bridges.

South of the industrial region lie Belgium's highlands. The northern part is important for farming and supplies dairy products to the industrial towns. In the south-east are the wooded Ardennes Mountains, which are only 693 metres (2,274 feet) at their highest point. The Ardennes region has poor soil, and is thinly populated.

Belgium's prosperity depends on its mining and manufacturing. Only about 4 out of every 100 people work on the land, and Belgium has to import food. Imports of petroleum through Antwerp have recently led to new industries being set up in the north. Together with the development of the Campine in the north-east, this has further reduced the importance of the southern industrial region.

The people of Belgium speak one of three languages – Flemish (a Dutch dialect) in the north, French in the south and German in the south-east. For centuries, there has been conflict between the Flemish and French speakers.

Luxembourg

Luxembourg is a small, landlocked country, bounded by Belgium, Germany and France. The north is crossed by the Ardennes Plateau, which extends from Belgium. In the south is low, rolling country, which is part of the Lorraine Plateau extending from France. This area contains the capital city, Luxembourg (78,000), which is a picturesque commercial centre.

Iron ore is mined in the south, and the iron and steel and metal-working industries are important. About a quarter of the Luxembourg people work in farming, and the chief crops are barley, oats, potatoes, sugar beet and wheat.

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THE BRITISH ISLES

The British Isles contain Great Britain (England, Scotland and Wales); Ireland (Northern Ireland and the Republic of Ireland); the Isle of Man; and the Channel Islands. The Isle of Man has its own government, but Britain controls some of its affairs, such as foreign relations and trade. The nine Channel Islands are British, although they mainly govern themselves. The Isle of Man and the Channel Islands both attract many tourists.

The most important part of the British Isles is the *United Kingdom* (UK), which consists of England, Scotland, Wales and Northern Ireland. The UK is a densely populated country, especially in England and Wales. In Europe, only the Netherlands is more crowded than England and Wales. The Republic of Ireland has been separate from the UK since 1921. It has far fewer people than the UK. In fact it now has less people than it had in 1840. Many Irishmen emigrated because their country was so poor.

Climate

The British Isles have a moist, temperate climate. An extension of the warm Gulf Stream passes the British Isles. Onshore winds are warmed by the sea and give the British Isles a mild climate for its latitude. Average monthly temperatures do not exceed 18°C (65°F) in summer, or fall below 3°C (37°F) in winter. Rainfall is heaviest in the highland regions, and reaches 2,000 millimetres (80 inches) in places. But it decreases to 760 mm (30 in) in the east.

However, the British Isles has very variable weather. Heat waves may occur in summer, and winters are sometimes very cold. Conditions on the European mainland affect the weather. So do depressions which form over the Atlantic Ocean.

Physical Features

The British Isles can be divided into two main regions: highland Britain and lowland Britain. Highland areas occur in Ireland, Scotland, Wales, the north of England and the south-west peninsula of England (Devon and Cornwall). The highest peak in Ireland is Carrantuohill in the south-west; it reaches 1,041 metres (3,414 feet). The highest mountain in Scotland is Ben Nevis (1,343 metres, 4,406 feet). Snowdon, in northern Wales, reaches 1,085 metres (3,560 feet). England's highest point is Scafell Pike (964 metres, 3,162 feet) in the north-west.

The lowlands of Britain consist mainly of rolling hills separated by vales. The British Isles has many rivers, most of which are short. The longest is the Shannon in Ireland, which is about 400 km (250 miles) long. Britain's longest rivers are the Severn (355 km, 220 miles) and the Thames (340 km, 210 miles).

An apple orchard in bloom in Kent, which is one of Britain's foremost fruit-growing districts.

The United Kingdom

The United Kingdom of Great Britain and Northern Ireland is one of the world's great manufacturing and trading nations. More than one-third of the people work in manufacturing. Only about 3 people out of every 200 work in agriculture.

The Industrial Revolution began in Britain in the late 1700s. During the 1800s it became the world's greatest manufacturing nation. It led the world in trading partly because of its large overseas empire. But the British Empire no longer exists, and several other countries have now overtaken Britain in world industry and trade. However, trading remains essential to the economy.

Although its farming is very efficient, the UK still has to import food. In the wetter highland regions, livestock farming is most important. Livestock include nearly 29 million sheep and 16 million cattle. Dairy farming is especially important.

Arable, or crop, farming is the leading kind of agriculture in the drier, eastern parts of the country. Leading crops include wheat, barley, and other cereals, potatoes, sugar beet and vegetables. Market gardening flourishes around thickly populated areas. Early crops grow in areas with mild climates, such as Cornwall, the Channel Islands, and the Scilly Islands off the Cornish coast.

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The River Thames winds its way through the heart of London under many bridges, including the famous Tower Bridge (foreground), situated near the ancient Tower of London.

The UK is mainly an industrial nation whose growth depended on the coalfields. Recently, however, coal mining has declined, and the UK now has to import fuels. Iron ore is also mined in some quantity, but the iron and steel industry requires large quantities of imported iron ore. The UK imports many other metals.

In the mid-1970s the UK faced many problems, because the amount of money it paid for its imports was far greater than the money it received for its exports. In other words its *balance of payments* was unfavourable. One expensive item was petroleum, whose price increased by about four times between 1973 and 1975. However, large reserves of natural gas and petroleum exist under the North Sea. They are already being tapped. When the petroleum deposits are fully exploited, the UK should have more petroleum than it needs.

In many of the large cities, consumer industries are important. These industries produce such items as television sets and home appliances – washing machines, vacuum cleaners, and the like. About eight out of every ten people live and work in cities and towns. England has six cities with more than 500,000 people. They are Greater London (7,167,000), Birmingham (1,086,000), Leeds (748,000), Liverpool (561,000), Sheffield (561,000) and Manchester (516,000). (Greater Manchester, including the urban areas around it, has 2,718,000 people.) The chief cities of Scotland are Glasgow (894,000) and Edinburgh (543,000). The largest city in Wales is Cardiff (285,000). Northern Ireland's largest city is Belfast (362,000).

England

England has very varied scenery for its small area. Highlands composed of ancient rocks occur in the north and south-west. Lowlands composed of more recent rocks cover the east and south.

Lowland England is a rich region of rolling countryside. It is crossed by ranges of hills separated by fertile plains. The rolling

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hills consist of tilted layers of rock. They generally have a steep slope, or *scarp*, on one side, and a gentle slope on the other. Between the hills are vales, containing softer rocks such as clays. These soft rocks have worn away faster than the harder rocks in the hills.

Northern England: Two highland areas occur in northern England. The *Cumbrian Highlands* are in the north-west. This beautiful region contains long lakes of glacial origin, and is known as the *Lake District*. The lakes include Coniston Water, Ullswater, Derwentwater, Windermere and Grasmere. England's highest peak, Scafell Pike, is in the Lake District. Livestock farming is important in the region, which is also a popular tourist area.

Running north–south through northern England is the rugged *Pennine* chain. The Pennines form the backbone of northern England. They contain lakes and reservoirs which supply water to nearby industrial areas. Along the edges of the Pennines, there are several coalfields, on which the manufacturing regions were founded.

The north-east industrial region is based on the Northumberland–Durham coalfield. It is served by the port Newcastle-upon-Tyne. Newcastle was once a major coal exporter. The phrase 'taking coals to Newcastle' came to mean taking something to a place where there is already plenty.

There is a small industrial region based on the Cumberland coalfield in the north-west, but it is much less important than the coalfields and manufacturing regions of Lancashire and Yorkshire. The Lancashire region includes Manchester, Liverpool, and other centres. It is important for its textiles (especially cotton), iron and steel, and chemical industries. To the south the North Staffordshire coalfield's chief centre is Stoke-on-Trent (258,000). This area is famous for its pottery. To the east of the Pennines, the Yorkshire–Nottinghamshire coalfield has famous woollen textile industries. This region contains the cities of Leeds and Bradford (461,000).

South-west England is England's other chief highland region. It contains the *Exmoor Plateau* in the north, and the smooth granite moorlands of *Dartmoor* in the south. The chief occupation is cattle farming, particularly dairy farming. But the mild climate of the far south-west enables farmers to cultivate crops of early potatoes and vegetables. The rugged coastline boasts some of the finest scenery in the British Isles. That and the generally mild climate make the region a favourite resort area. The largest city is Plymouth (251,000), which is an industrial seaport.

At the extreme south-west tip

Right: Docks on the River Mersey near Liverpool, Britain's second largest port.
Below: Land's End, the most westerly point in England.

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of Cornwall is Land's End. John o'Groat's is at the extreme north-east of Scotland. The distance from Land's End to John o' Groat's is 1,405 km (873 miles).

The Midlands occupies a mainly flat region in Central England. It contains major industrial centres, including Birmingham. This is one of the world's greatest manufacturing cities. Coventry (335,000), Dudley (299,000), Walsall (271,000) and Wolverhampton (268,000) are other important industrial centres. Industrial development was based at first on local coal and iron ore. This led to the development of varied metal industries, including heavy engineering and motor cars. Around the industrial cities are market towns which are centres of intensive farming areas.

Limestone Hills: The Mendip Hills are a steep-sided limestone range in western England. North of the Mendips, the limestone Cotswold Hills stretch away to the north-east. They extend through the Midlands as the uplands of Northamptonshire. Although interrupted, they reach eastern Yorkshire as the Cleveland Hills. Sheep and mixed farming are practised on the hills. Many beautiful villages are built from the local grey limestone.

In the south the Cotswold Hills overlook the plains of the River Severn. Near the mouth of the Severn is the port of Bristol (418,000). Bristol was formerly the main port for trade with the Americas. It still has industries, producing such things as chocolate and cigarettes, which use imported materials. The uplands of Northamptonshire lie east of the industrial plain of the Midlands. Iron ore lies close to the surface in the Northamptonshire area. The Cleveland Hills also contain iron-ore deposits, but they are deep and are no longer mined.

The lowland vales between the limestone hills and a similar range of chalk hills to the east are mostly fertile clay plains. The vales contain several large towns, including Swindon, Oxford, Bedford and Cambridge, and many small market towns. In eastern England, the vales extend into the Fens – a flat farming region resembling the Netherlands.

The Chalk Hills of lowland England spread outwards from Salisbury Plain. One range is the Dorset Downs, which extends south-westwards. Another range continues into the South Downs of south-east England. Between these chalk ridges lies the Hampshire Basin, which contains the ports of Southampton (213,000) and Portsmouth (200,000). Many holiday resorts border the coast and the Isle of Wight offshore.

To the east of Salisbury Plain, the chalk hills are called the North Downs and to the north-east the Chiltern Hills. The Chiltern range extends into East Anglia, which is a low plateau with a sunny, dry climate. Arable farming is very important there. The North and South Downs of south-east England enclose a farming area called *the Weald*,

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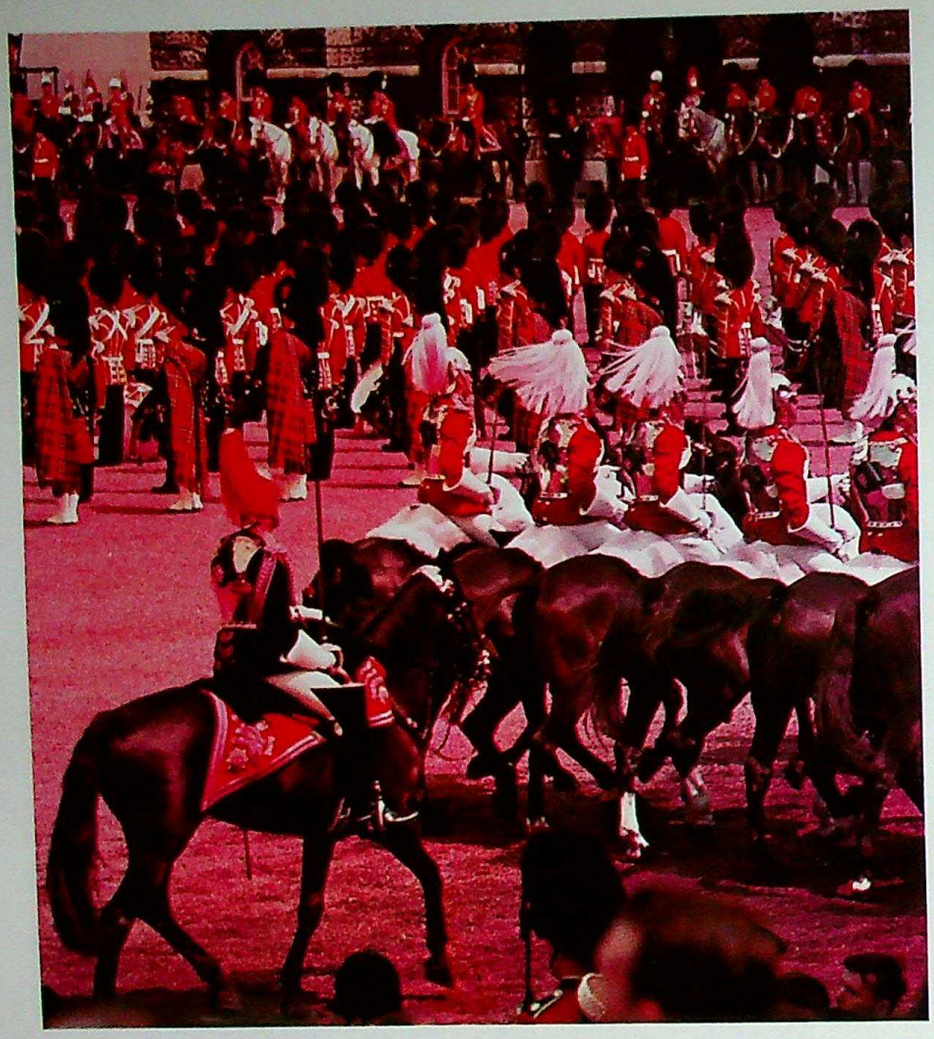

The colourful ceremony of the Trooping of the Colour, held early in June to celebrate the Queen's official birthday.

noted for its sheep. Some people who work in London have homes in the Weald area or in the many resorts around the coast.

The London Basin: Between the Chiltern Hills and the North Downs is the downfolded London Basin. This basin contains clays and sands. It is drained by the River Thames, which rises in the Cotswolds.

London is the UK's greatest commercial centre and the seat of government. It has a large industrial complex, producing many consumer goods. London and the south-east are the most populous regions of the UK.

Wales

Wales has a special character. The Welsh language is spoken widely, by about two out of every ten people. Many Welsh people believe that they should have their own government, with a parliament in the capital, Cardiff.

The country consists mainly of a large highland. The most thickly-populated area is the industrial area in South Wales. The chief geographical regions are North Wales, the Welsh Highlands, South Wales and the Welsh Borderlands.

North Wales has a narrow coastal plain where several large seaside resorts are situated. Off the north-west coast is the large island of Anglesey. It is a rolling area, where rich grasslands support dairy cattle.

The Welsh Highlands rise steeply from the northern coast to Wales's highest peak, Snowdon. The highlands are wet, bleak and windswept. They were once covered by glaciers, and the glaciated scenery is very rugged. In central Wales the highlands are more rolling and plateau-like in character. The region is thinly populated. Sheep farming is important on the high grasslands, arable farming in the valleys.

South Wales contains a major industrial area. It is based on a large coalfield which extends from Newport (135,000) in the east, through Cardiff and Swansea (190,000), to Llanelli in the west. The mines are situated in deep valleys which run north–south through the coalfield. Iron ore was once mined there, and a large iron and steel industry developed. But today iron ore has to be imported. Major steel centres are located at Ebbw Vale, Port Talbot and Newport. Tinplating is another major industry.

The southern part of Wales also has important farming areas, including the Vale of Gwent, South Glamorgan (the Vale of Glamorgan) and Pembrokeshire. South Pembrokeshire is unusual because many English people have settled there and given the area a distinctly English character. It has fine beaches and is a popular tourist area.

The Welsh Borderlands, or Marches, is a hilly region extending north–south at the foot of the Welsh Highlands. Cattle and dairy farming are practised and fruits are grown, but the borderlands have no large towns.

Scotland

Scotland has been part of the UK since 1707. But, as in Wales, the Scots have maintained a strong feeling of nationalism. Many would like to be more independent from the rest of the UK. The Scots have a separate language, Gaelic, but less than 2 out of every 100 speak it. Most of the Gaelic speakers live in the remote north-west Highlands or on the Scottish islands. Scotland contains three main regions: the Highlands, the Central Lowlands and the Southern Uplands.

The Highlands are thinly populated. The region is divided into two areas by a deep valley called Glen Mór. This valley contains two long narrow *lochs* (lakes) – Loch Ness and Loch Lochy. Loch

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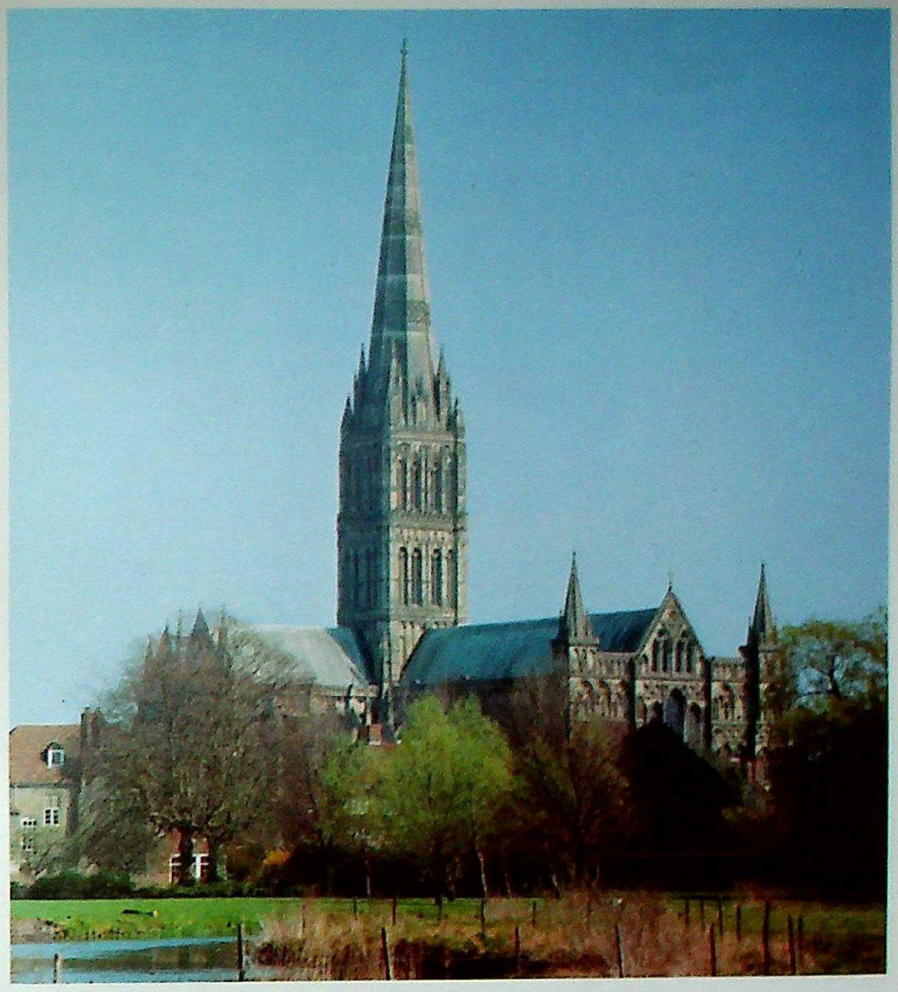
Ness is famous for its supposed 'monster'. North of Glen Mór lie the rugged north-west Highlands. The more gentle Grampian Mountains are to the south. The highest mountains, including Ben Nevis, are in the west. Many islands lie off the indented coast. To the north lie the Orkney Islands, which can be seen from the mainland. Farther north are the Shetland Islands, whose people are of Scandinavian origin. To the west lie the Inner and Outer Hebrides island groups. The largest island is Lewis with its southern extension Harris, famous for tweeds.

Rainfall is very heavy in the western parts of the Highlands. The few people who live there earn their living by fishing, spinning and weaving, and growing such crops as oats and potatoes. In the drier east-coast region cattle farming is important, and the chief crops are fodder for animals. The chief city of the Highlands is Aberdeen (182,000). It is a fishing port and oil-exploration base with paper, metal and textile industries.



Above: Salisbury Cathedral, built mainly in the 13th century, is one of the finest cathedrals in Britain. Its spire is 123 m high.
Below: Rows of identical houses line the streets of this typical Welsh mining town.

The Central Lowlands are where most of Scotland's industries and most of the people are found. These lowlands also contain large farming areas, where cattle are reared, and barley, oats and potatoes are important crops. The Central Lowlands contain three coalfields. Around the Lanarkshire coalfield there are various industrial centres, including the great city of Glasgow. Glasgow is a major port, with chemical, engineering, steel and textile industries. Shipbuilding is important near Glasgow on the River Clyde. The city also has industries which process imported materials. Lanark and Paisley have textile industries. Near Motherwell there are large steelworks. Other important cities in the lowlands include Dundee (183,000) and Edinburgh. Dundee is famous for its jute industry. Edinburgh is the elegant capital of Scotland, with a fine castle.

The Southern Uplands have more gentle scenery than the Highlands. The low-lying areas in the south-west are important for farming. In wetter areas cattle and dairy farming are important. Sheep graze on the grass-covered uplands. In the south the Southern Uplands rise to the Cheviot Hills on the English border.

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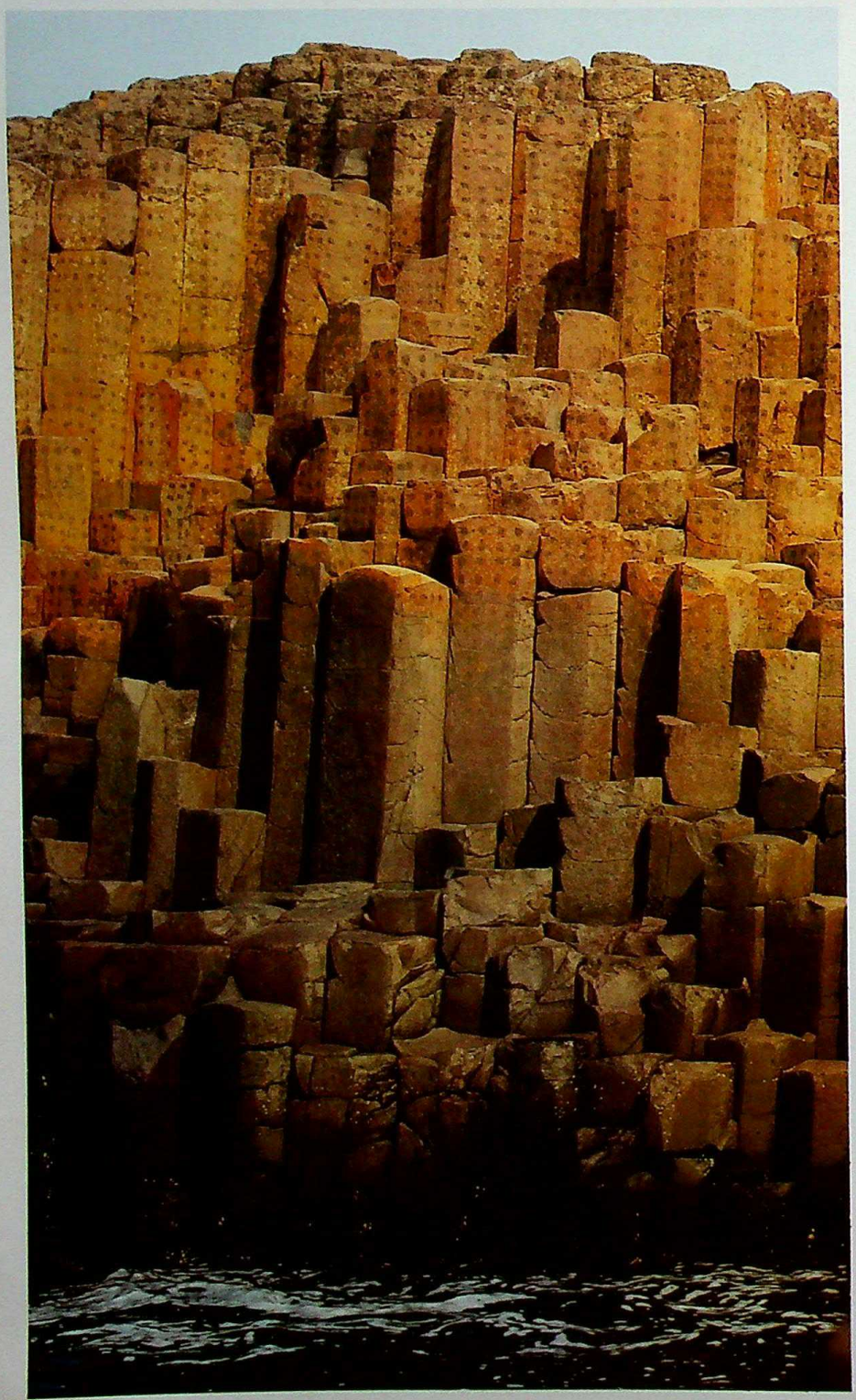
Ireland

Ireland is the second largest island in the British Isles. Six counties in the north-east form Northern Ireland, which is part of the UK. They are Antrim, Armagh, Down, Fermanagh, Londonderry and Tyrone. The other 26 counties form the independent Republic of Ireland. Most people in the Republic of Ireland are Roman Catholics, but the majority in Northern Ireland are Protestants. Many people in both countries favour a united Ireland, but the Protestants in Northern Ireland want to remain part of the UK. Because of these differences, violent conflict between Protestants and Roman Catholics has occurred in Northern Ireland, especially since 1969.

The spectacular basalt columns of the Giant's Causeway, on the northern coast of County Antrim, in Northern Ireland. The columns are mainly hexagonal in shape. They are riddled with caves.



Northern Ireland contains mountain masses and damp lowlands. Lough Neagh, the largest lake in the British Isles, occupies a depression in the centre. It has an area of about 395 square kilometres (153 square miles). An important crop is flax, which is used to make linen, especially in Londonderry and Belfast. Barley, hay, oats and potatoes are other major crops. The Northern Ireland capital Belfast lies in the east. It is the North's chief manufacturing centre, where textiles and shipbuilding are major industries. The south-west of Northern Ireland is thinly populated.

So is the north-west (Donegal and Leitrim) of the Republic of Ireland. Central Ireland is a large, low-lying region, with some good farmland. Peat bogs occur in some areas. Peat is used as fuel. An important farming region lies inland from the Irish Republic's capital Dublin (568,000) in the east. Dublin is a beautiful city. Although it has brewing, milling and textile industries, it is not an industrial centre.

Western and southern Ireland are in general mountainous. Western Mayo and Galway are sparsely populated. In the south rich lowlands lie between the highland masses. They include the Golden Vale of Tipperary, where dairy farming is important. There are few towns. The largest is the port of Cork (129,000).

The Republic of Ireland is mainly a farming country. Three-fifths of its exports consist of farm produce, particularly butter. Because Ireland has a mild, wet climate, livestock farming is most important. Arable farming is confined mainly to the drier eastern areas. Most of the Republic's trade is with the UK. And so, when the UK joined the European Common Market (EEC), the Republic also joined. The Republic of Ireland has little coal, and it is less industrialized than Northern Ireland. Most manufactures are processed farm products. As a result, the country is relatively poor.

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FRANCE

Nôtre Dame cathedral, built 1163-1313, is one of the best-known landmarks of Paris.

France has a great variety of climate and scenery. The climate changes from west to east and from north to south. The mild, moist climate of the west gradually gives way to increasingly continental conditions in the east. Average temperatures increase from north to south. The north has a cool, temperate climate. The southern coast has typical Mediterranean conditions, with hot, dry summers and cool, moist winters. The climate of the highland regions is moderated by the altitude.

Mountain ranges border France in the south and south-east. The central plateau of France covers one-sixth of the total land area. This plateau contains the headwaters of most of France's main rivers – the Dordogne, Garonne, Loire and Seine.

France can be divided into these main regions: the north-west peninsula; the Paris Basin and the industrial north; the north-east borderlands; the Aquitaine Basin; the central plateau; the Rhône–Saône valley; the Mediterranean region; and the Alps.

The North-West Peninsula

The north-west peninsula is a beautiful, rugged area composed of ancient rocks. Its ragged coastline contains long sea inlets. The region includes the ancient province of Brittany, where the Breton people have their own language. They are distantly related to the Cornish people, in south-west England. The region includes western Normandy and extends south to La Vendée.

Many of the coastal people are fishermen, and sardine canning is important in some towns. Inland the chief activity is livestock farming, especially dairy farming on the lush grasslands. Fruit orchards and market gardening are also important.

The largest city of the north-west region is Nantes (population 394,000). Nantes stands near the mouth of the River Loire. It is connected with the port of St Nazaire by a ship canal. Shipbuilding is one of the main industries. Cherbourg, on the Contentin Peninsula to the north is a major port. Brest, in the extreme west, is an important naval base. On the estuary of the River Rance in northern Brittany is the world's first power station to harness the energy of the tides.

The Paris Basin and North-East Borderlands

The Paris Basin consists of rings of hills, separated by clay depres-

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sions. The hills dip gently inwards towards the centre of the basin but slope steeply outwards. The region includes the basins of the River Somme in the north, the River Seine in the centre, and the middle Loire in the south. The beautiful capital city of Paris straddles the Seine in the centre. This great route centre, cultural and industrial city has a population of 8,197,000 with its suburbs.

Around Paris the basin contains large areas of fertile farmland. In the limestone Beauce region to the south-west, wheat-growing and sheep-farming are the chief activities. To the south-east, Brie is famous for its dairy products, especially cheese. To the east of Paris, there are vine-growing regions. They include the Champagne district, which is noted for its sparkling wine. To the north, fruit-growing and dairy farming are important. Major towns include Le Havre (247,000), France's second most important port, and Rouen (370,000).

In the south of the Paris Basin is the rich middle Loire region. It contains ancient market towns such as Angers, Orléans and Tours. In the north, near the Belgian frontier, there is a major industrial region. An extension of the Belgian coalfield occurs around Lens (326,000) and Valenciennes (224,000). Industries in this region include textiles and engineering. The biggest industrial centre is Lille (881,000).

The north-east borderlands extend from the Moselle River, which flows northwards into Belgium, to the River Rhine, France's eastern boundary with Germany. This plateau region rises in the south-west to the Vosges Mountains, whose maximum height is 1,424 metres (4,672 feet).

The area is rich in minerals, especially iron ore in the Lorraine area. Iron ore is exported to Germany, via the Rhine, while German coal is imported. Nancy (258,000) is one of the main industrial centres. Strasbourg (335,000) is a commercial centre and river port with a canal connecting it to the Rhine.

The Aquitaine Basin and Central Plateau

The low-lying Aquitaine Basin in south-west France is bordered in the east by the central plateau. To the south lie the scenic Pyrenees, which peak to more than 3,350 metres (11,000 feet) over the Spanish border. Behind a sandy coast, most of this Aquitaine Basin is fertile farmland, where maize, vines and wheat flourish.

The port of Bordeaux (555,000), on the River Garonne, is the main commercial and industrial centre for south-west France. Around Bordeaux are some of the world's most famous wine districts, including Médoc, Graves and Sauternes. Toulouse (440,000) in the south-east is another large industrial town. Petroleum is extracted in this region, and natural gas is obtained in the Pyrenees.

The central plateau, or Massif Central, is a beautiful but thinly-populated region. It lies at an average of 915 metres (3,000 feet)

Fishermen mending their nets in Marseilles, France's chief port, on the Mediterranean Sea.

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above sea level. Part of the plateau consists of old volcanic rocks. Part is limestone scenery, with deep gorges, disappearing streams and underground caves. The central plateau has some coal, including one field around the largest town St Etienne (331,000). But livestock farming is the main occupation.

The Rhône–Saône Valley and the Alps

Sandwiched between the Massif Central and the forelands leading to the French Alps lies the valley of the River Rhône. This north–south valley is a continuation of the valley of the River Saône, which joins the Rhône at Lyon. East of the Saône valley the land rises to the Jura Mountains on the Swiss border. In the Saône valley, north of Lyon, cattle are raised, and vines and wheat are cultivated. This is the Burgundy region, which is famous for its wine. Dijon (184,000) is the main centre.

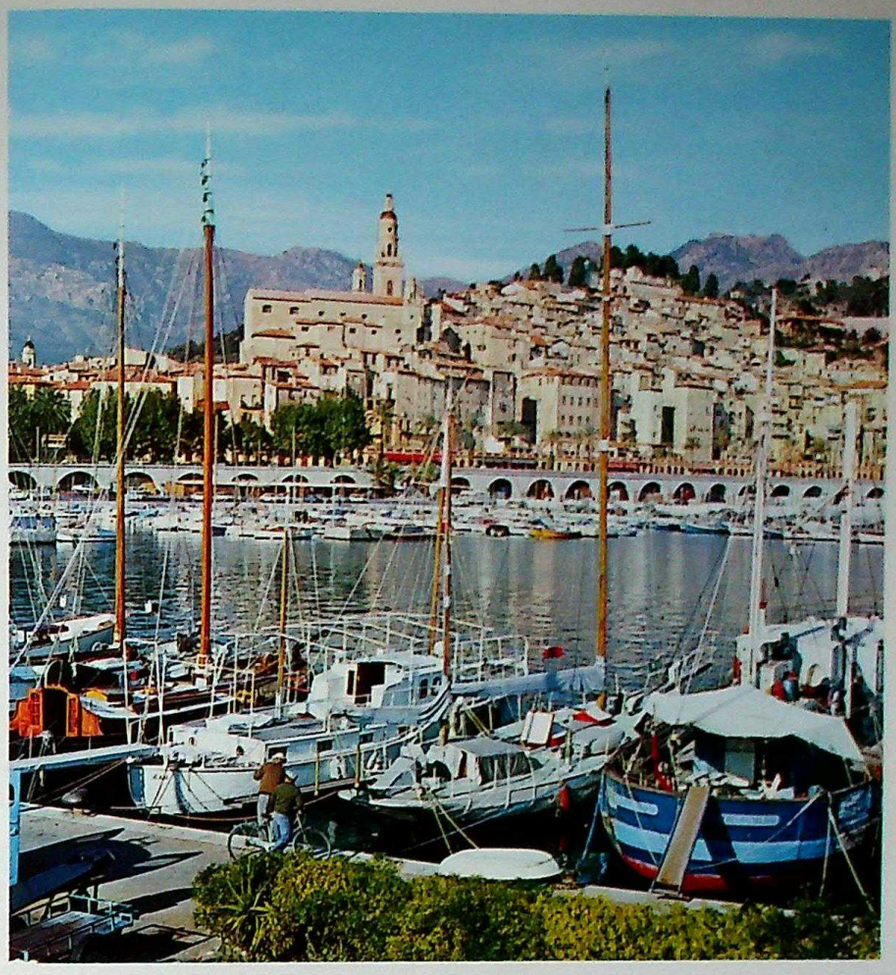
Lyon (1,075,000), France's second largest city, is noted for its silk and textile industries. South of Lyon, the River Rhône flows through a drier region, which becomes increasingly Mediterranean in character.

The beautiful French Alps separate France from Italy. Grenoble (332,000) is the chief city. It has several industries. Hydroelectric stations provide power for various industries in other towns. France's highest peak, Mont Blanc, reaches 4,810 metres (15,781 feet) on the Italian border.

The Mediterranean Region

Mediterranean France contains the lower Rhône valley and the coastal strip. The largest city, Marseille (964,000), lies east of the Rhône delta. It is France's chief port. South-east of Marseille is the naval station of Toulon (340,000). Further along the coast is the famous resort of Nice (393,000). Beyond Nice is the small, independent state of Monaco, which is governed by a prince. Its capital Monte Carlo is noted for its gambling casino.

The whole coastal region from Hyères to the Italian border is called the French riviera. It is one of the best-known resort areas in the world. It is sheltered by the Alps and has a balmy climate even in winter.



The fine harbour of Menton, one of the many popular summer and winter resorts along the famous Côte d'Azur, or azure coast.

In the Mediterranean Sea lies the mountainous French island of Corsica. It is the fourth largest island in the Mediterranean, and is separated from the Italian island of Sardinia by a 15-km (9-mile) strait. Ajaccio is the capital. There is some cultivation on the narrow coastal plain. In the rugged interior sheep are raised. Products include wool, cereals, chestnuts, olives and wine.

Economy

Although manufacturing has been increasing quickly, France still depends greatly on farming. More than a tenth of the working people are still employed in agriculture – a far higher proportion than in Britain or West Germany. Because of its varied climate, France can produce a great variety of crops. It also has a flourishing livestock industry. About three-fifths of the country is suitable for farming. France is among the world's top five producers of barley, flax, oats, sugar beet and wheat. It leads the world in the production of fine wines.

France's chief exports include chemicals, iron and steel goods, machinery (including cars), textiles, wines and spirits, luxury goods and beef. France has rich reserves of iron ore. Through the European Economic Community (EEC), it gets coal on favourable terms from West Germany. Imports of petroleum, together with its own petroleum and gas deposits, have helped the chemical industry to expand rapidly. France also has well developed hydroelectric power resources, and has many nuclear power stations. Traditional industries, including textiles and such luxury items as cosmetics, jewellery and perfume, continue to grow.

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GERMANY

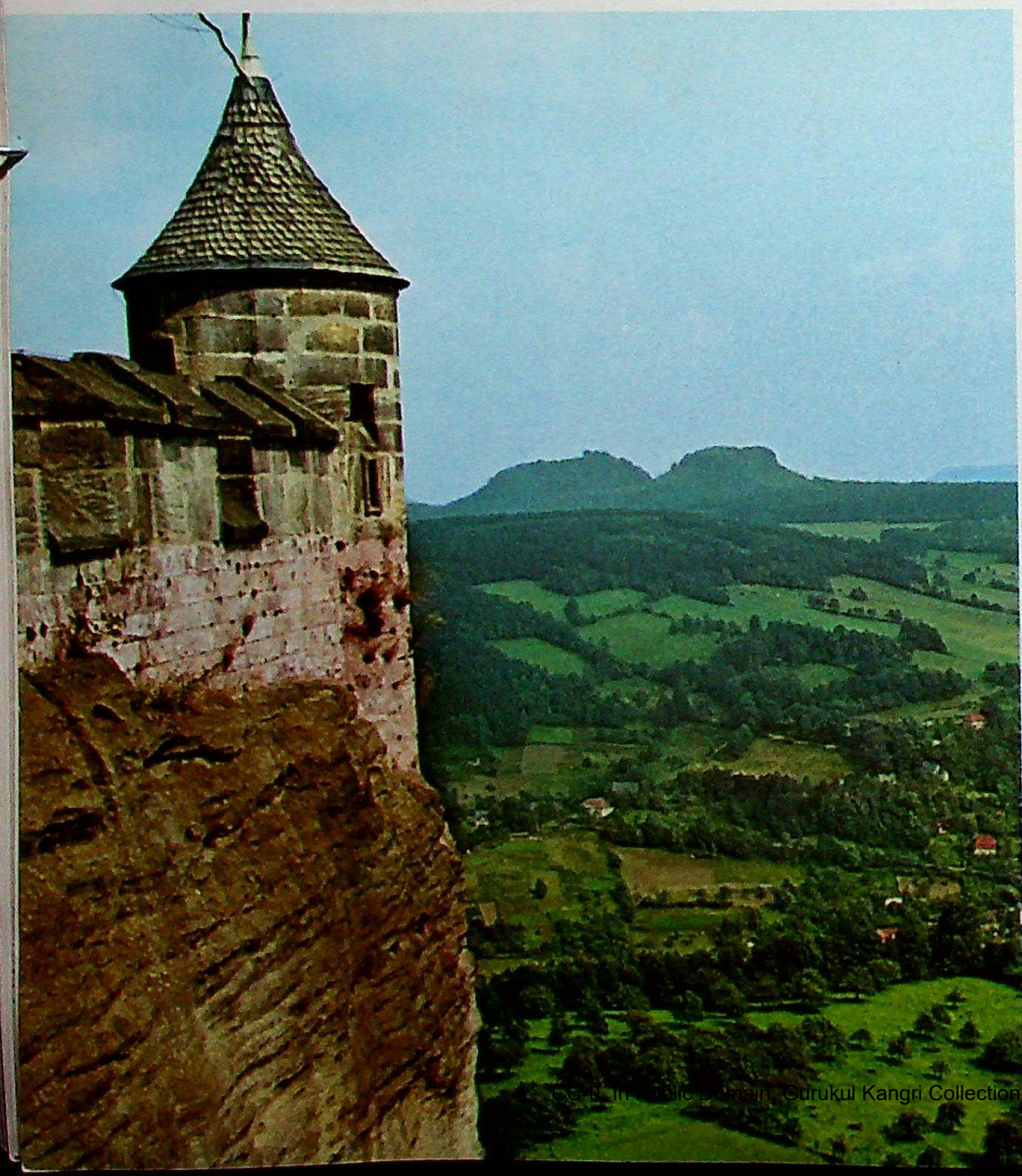
In 1945 Germany surrendered to the Allies to end World War II in Europe. Conquered territories were returned, and a large part of eastern Germany was taken by Poland. The eastern border of Germany was fixed along the Oder and Neisse rivers. Germany lay in ruins, and the situation of the people was desperate. To restore normal conditions, the Allies divided the country into four military zones, governed by the Americans, British, French and Russians. The capital, Berlin, lay within the Russian zone. But it was divided among the Russians and Allies into four sectors. In 1945 people considered that these divisions would continue only for a short time and that Germany would finally be reunited.

By 1948 the American, British and French zones had become one unit. But the Russians kept control over their zone. In 1949 two Germany states were established. West Germany became a federal republic. But a communist government took control of the Russian zone of East Germany.

Today West Germany (the Federal Republic of Germany) and East Germany (the German Democratic Republic) are separate countries. Berlin remains divided into two parts. West Berlin (population 2,048,000) has its own government, but is effectively part of the Federal Republic. East Berlin (1,089,000) is the capital of the German Democratic Republic (DDR from its initials in German). The capital of the Federal Republic (BRD from its initials in German) is Bonn (283,000).

Germany has four main land regions. The northern plains and central Germany extend across the Federal Republic and the DDR. South-west Germany and southern (Alpine) Germany are entirely in the Federal Republic.

For many centuries, the castle at Königstein has dominated the Elbe's narrow valley near Dresden.



Northern Plains

The northern plains border the Baltic Sea in the east and the North Sea in the west. The Federal Republic's coastline contains long inlets. Sand dunes fringe the coast of the DDR. Hamburg (1,752,000) and Bremen (584,000) are the Federal Republic's leading ports and the leading industrial centres of northern Germany. Hamburg lies on the River Elbe; Bremen has its outlet Bremerhaven on the River Weser. The DDR's chief port is Rostock (207,000).

The northern plain was covered by ice sheets during the Ice Ages. In the north there are moraine hills formed of deposits left by the glaciers. Between the hills, lakes and marshes occur, especially in the DDR. To the south is a central depression. It is drained by rivers that occupy courses formed by water from the melting ice sheets. Berlin lies in one of these glacial valleys. Rivers and canals are important means of communication.

In the west, sandy soils are spread over large areas, such as Lüneberg Heath. In the east swamps and forests are common. The northern plain is not particularly fertile. Rye and potatoes are the chief crops. Dairy farming is also important in many areas.

Central Germany

The highlands of central Germany are the richest and most thickly populated region in the country. In the DDR, the region includes the southern areas of Saxony and Thuringia. In the Federal Republic, it includes North Rhine-Westphalia and the middle Rhineland region.

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The River Rhine near Cologne, in western Germany. It is Europe's main industrial waterway.

Saxony and Thuringia contain the DDR's best farmland. It also contains the chief mining and industrial areas, apart from Berlin. Around Magdeburg, there is a very rich farming region where sugar beet and wheat are major crops. There are large reserves of lignite (low-grade coal) around Halle (246,000). The massive potash deposits around Stassfurt are world famous. Industries are very varied. Saxony has long been known for the quality of its textiles, metalwork and scientific instruments. Other major industries produce chemicals, clothing, glass, leather goods and pottery. Among the main industrial centres are Dresden (506,000), Erfurt (202,000), Karl-Marx-Stadt (302,000, Magdeburg (274,000) and Leipzig (574,000).

North Rhine-Westphalia includes the Ruhr. This is the most important industrial region in Germany, and one of the biggest in the world. The River Ruhr is a tributary of the Rhine. Industry grew up because of the rich coalfields there. Iron ore is imported from Lorraine in France for the Ruhr's large steel-making plants. Metalworking and other heavy industries are also important, as is the textile industry. Industrial centres include Essen (674,000) and Dortmund (632,000). Düsseldorf (628,000), Cologne (Köln; 832,000) and Duisberg (435,000) are major river ports.

Another industrial region lies north of the Ruhr around Hanover (Hannover; 505,000) and Brunswick (Braunschweig; 218,000). To the south of the Ruhr region is a highland area drained by the River Rhine and its tributaries. The Rhine valley is a fertile region, and the rivers are major thoroughfares. The largest city, Frankfurt am Main (663,000), is an industrial and trading centre.

South-West and Southern Germany

The south-west region includes the highlands bordering the Middle Rhine valley in the south-western part of the Federal Republic. It also includes the highland area east of the Rhine. The highlands include the Black Forest and the Odenwald. Fertile soils and warm summers make this area one of the richest farming regions in Germany. Fruits, hops, tobacco, sugar beet, wheat and vines flourish. To the west the Saarland is a productive coal-mining region, where there are also many other industries. To the east the highland region includes the ancient, but now industrialized cities of Stuttgart (625,000) and Nuremberg (Nürnberg; 515,000).

Southern Germany fringes the Alps. The Alpine forelands include the region known as Bavaria. Farming in this region is mainly pastoral. There are several industrial centres, which use

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hydroelectric power from the rivers. One of the most important of these is Munich (München; 1,336,000). It is the Federal Republic's third largest city.

The West German city of Munich is one of Europe's foremost cultural, business and industrial centres, founded in 1158.

West German Economy

Both the West and East Germans made remarkable recoveries after 1945. Their success has owed much to the revival and development of industry. But they have each adopted very different methods.

The recovery of the Federal Republic was at first helped by aid from the United States. But several other factors also played their part. After World War 2 ended, several million refugees flooded into the West, some from former German territories and some from the DDR. As the Federal Republic recovered, these immigrants formed a useful labour force. More than 2,500,000 'guest workers' are still employed today. They come from Turkey, Italy, and other countries.

The West Germans set an example to the rest of Europe in hard work. They rebuilt their shattered industries, replacing old machinery with new. In the late 1950s they began to import large amounts of cheap petroleum. This caused many coal mines to close down. But, by using petroleum, new industries were established away from the coalfields. The West Germans have also been aided by their membership of the European Economic Community (EEC), or Common Market.

The Federal Republic is the most industrialized country on the West European mainland, although the number of people working in agriculture still exceeds that of Britain. But the relative importance of agriculture has declined. In 1939 about 20 out of every 100 Germans worked on farms. In the early 1970s only 7 out of every 100 were farmworkers. Most farms are small, but many have been joined together to make them more efficient. The Federal Republic still imports food.

A welder at work in a factory at Essen, in the Ruhr, one of Europe's main industrial centres.

East German Economy

The DDR's economic recovery has been faster than that of any other European communist country except for the USSR. However, the East Germans have a lower standard of living than the West Germans.

The relative importance of farming in the DDR also has declined. More than three-fifths of its national income now comes from manufacturing. Soon after the war ended, the East Germans were encouraged by the USSR to set up new industries, including iron and steel works. They had to import many materials to operate these industries. But it nevertheless has mineral resources of its own. For example, it is the world's leading producer of lignite, and it has massive deposits of potash and other salts for its important chemical industries. Most industry in the DDR is state-owned, as it is in other communist countries.

In agriculture the East Germans have followed the communist policy of setting up collectives (co-operatives) and state farms. But progress in farming has not been as great as in manufacturing, and food must be imported.

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ALPINE EUROPE

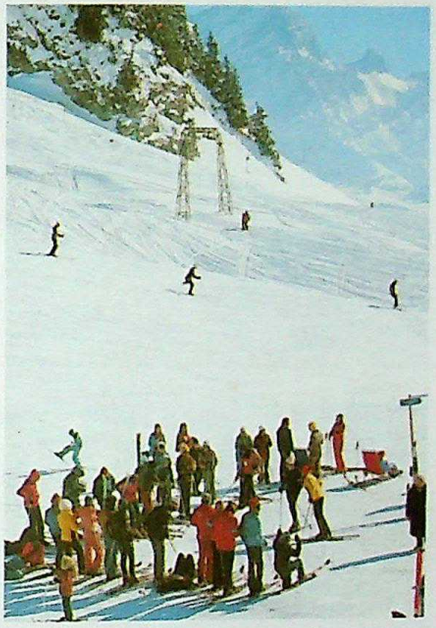
Switzerland

Switzerland is a small but complex country, where several languages are spoken. About 75 out of every 100 people speak Swiss-German, 20 speak French, 4 speak Italian. The rest speak Romansch, which is derived from Latin, or other languages. Despite language differences, however, the Swiss people have united to create a prosperous neutral country. The Swiss probably enjoy the highest standard of living in Europe.

Nearly half of the people work in industry and construction. Because they lack many resources and communications are difficult, the Swiss have achieved success by concentrating on the highest standards of workmanship. They make items such as watches and scientific instruments, which require great skill but few materials. They manufacture goods such as cheese, chocolate and condensed milk from local dairy produce. Their tourist industry is also very important.

Switzerland is a beautiful country. The central plateau, where three-quarters of the people live, is the chief farming and industrial region. It is bounded by the Jura mountains in the west and north. The magnificent, snow-capped and forested Alps bound it in the south and east. In the mountains most farms are on the valley floors. But the higher slopes are used to graze livestock in summer.

The country's capital is Bern (population 282,000), but there are three larger cities: Zürich (715,000), Basel (378,000) and Geneva (318,000). Zürich is a great banking and insurance centre. Basel is an industrial city and an important Rhine river port. Geneva is the headquarters of many international organizations, such as the World Health Organization (WHO) and the European Organization for Nuclear Research (CERN). The United Nations has its European headquarters in the city.



Alpine Europe is a region of spectacular scenery which attracts visitors throughout the year. In winter skiing is the main attraction.

Liechtenstein

Liechtenstein has been a small independent principality (a country ruled by a prince) since 1719. But its origins date back to 1342. Closely linked with Switzerland, Liechtenstein has recently become industrialized. Its industries are very varied and include ceramics and textiles.

Austria

Austria is about twice the size of Switzerland. About seven-tenths of the land consists of high Alpine ranges. Like Switzerland, Austria has a flourishing tourist industry, especially for winter sports. The Alpine foreland in the north, which is crossed by the River Danube, is a major farming region. So are the Vienna lowlands, which contain the capital city Vienna (Wien; population 1,614,000). This region produces cereals, grapes, sugar beet and livestock. Vienna itself is a commercial, industrial and cultural centre.

Austria was occupied by Germany from 1938 to 1945. Since 1955, when all the occupying forces left, Austria has developed quickly as a neutral state. Although it imports coal, it possesses many other minerals. Its industries are mostly state-owned. Much of Austria's power, like Switzerland's, comes from hydro-electric plants.

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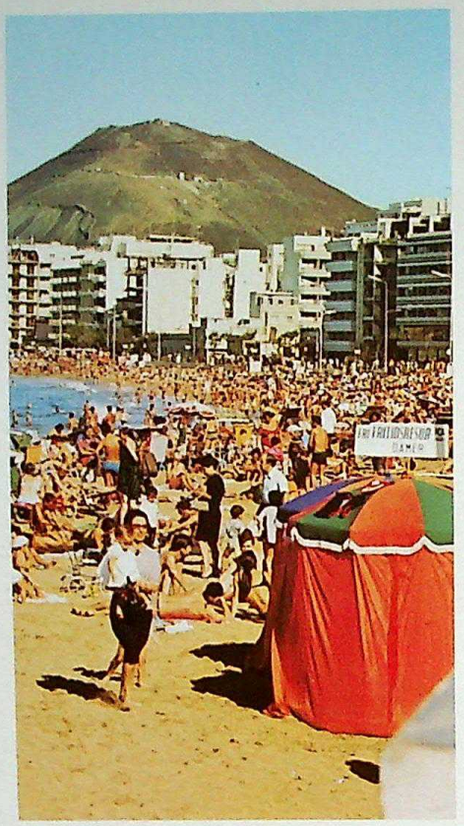
SOUTHERN EUROPE

The countries of southern Europe include Spain, Portugal, Italy, Greece, European Turkey and Malta. Excepting Portugal, they all have extensive coastlines along the Mediterranean. Portugal borders the Atlantic Ocean. With Spain it makes up the Iberian Peninsula. On a rocky peninsula of southern Spain is the tiny British military fortress of Gibraltar. Spain has often claimed Gibraltar, but in 1967 nearly all the people voted to remain British.

The southern European countries Albania and Yugoslavia border the arm of the Mediterranean called the Adriatic. They are described under Eastern Europe on page 129.



Left: A crowded beach on the balmy Balearic island of Majorca.
Below: A Portuguese potter shaping traditional earthenware pots.

Spain

In the 1500s Spain was the greatest power in Europe. But today it is under-developed in comparison with most of Europe. Manufacturing has increased steadily in recent years, but about 30 out of every 100 people still work on farms. The chief crops include barley, grapes for wine, olives, oranges and lemons, potatoes and wheat. Tourism is very important. In the early 1970s about 35 million tourists visited Spain every year, chiefly to enjoy the beaches on the mainland and on the Balearic Islands – Majorca (Mallorca), Minorca (Menorca) and Ibiza.

Most of Spain consists of a vast and largely treeless plateau, or *meseta*. Most of this is between 600 and 900 metres (about 2,000–3,000 feet) above sea level. For example, the capital Madrid (population 3,150,000), in the heart of Spain, is 655 metres (2,150 feet) above sea level.

In places the meseta is crossed by high ridges called *sierras*. Several mountain ranges surround the meseta. The rugged region of Galicia lies in the north-west. Physically, it resembles the Brittany region of north-west France. Between Galicia and the French border are the Cantabrian Mountains, or Cordillera Cantabrica. They reach heights of 1,830 metres (6,000 feet) or more. The Basque people, who live at the eastern end of the Cantabrian Mountains, have their own language. They also believe that they should have their own independent state.

The high Pyrenees separating Spain from France reach more than 3,350 metres (11,000 feet). Nestling in the Pyrenees is the tiny state of Andorra, which is controlled by France and Spain. Andorra depends mainly on tourism. Another mountainous area in the south, the Sierra Nevada, contains Spain's highest peak, Mulhacén. It is 3,481 metres (11,421 feet) above sea level.

The high meseta has cold win-

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Rome, the Italian capital, lies on the River Tiber. Among its fine buildings is the fortress Castel S. Angelo, dating to Roman times.

ters and hot summers. The low-lying plains have mild, moist winters and hot, dry summers. They are the chief farming regions. The rich plain of Andalusia in the south-west includes the ancient and beautiful city of Seville (Sevilla; population 548,000). On the Atlantic coast south of Seville is the famous port of Cádiz. It lies close to Jerez, noted for its sherry wine.

The plain of Aragon in the Ebro valley in the north-east is less important for farming because it is mostly dry. Around the Mediterranean coast are several smaller plains which are very fertile. Such plains occur around Valencia (population 654,000), Alicante and Murcia. Catalonia in the north-east is another farming region. Its centre, Barcelona (population 1,754,000), is a great port and manufacturing centre. Like the Basques, the Catalonians have their own language, and many favour independence.

Portugal

Portugal occupies about one-sixth of the Iberian peninsula. Like Spain, Portugal once ruled a great overseas empire. Today, however, it is one of Europe's poorest countries. Its chief exports are wine, sardines, cork and wood-pulp. Income from tourism is also important. Industries are being developed, especially iron and steel and textiles.

Most of Portugal consists of plateaux, but it is fringed by narrow coastal plains, where earthquakes sometimes occur. The capital Lisbon (Lisboa; population 1,034,000), on the River Tagus, is the country's chief port. Porto (750,000) on the River Douro, is the country's second largest city, noted for port wine.

Italy

Shaped like a boot, Italy is a long peninsula, extending nearly 960 kilometres (600 miles) into the Mediterranean Sea. Formerly an agricultural country, Italy has become a major industrial power. The car and chemical industries are particularly important. Today only 17 out of every 100 workers are employed in farming. More than 35 million tourists flock to Italy every year. They are attracted by the sunny climate, beaches, historical sites and cultural cities.

In the north Italy is fringed by the Alps. At the foot of the Alps lies the important Lombardy plain, which is drained by the River Po. Much of the plain is fertile. Wheat, maize, vines and mulberry trees flourish. Mulberry trees are cultivated for silkworms to feed on. Italy is Europe's leading silk producer. Cattle and pigs are raised in the pastures. The plain contains many beautiful old cities, including Venice (Venezia; population 366,000). Venice is built on a coastal lagoon of the Adriatic, and the main thoroughfares are canals, not roads. The plain also has several great industrial cities, including Milan (Milano; 1,743,000) and Turin (Torino; 1,199,000).

The Apennine Mountains form the backbone of the peninsula of Italy. The narrow northern Apennines form an arc around

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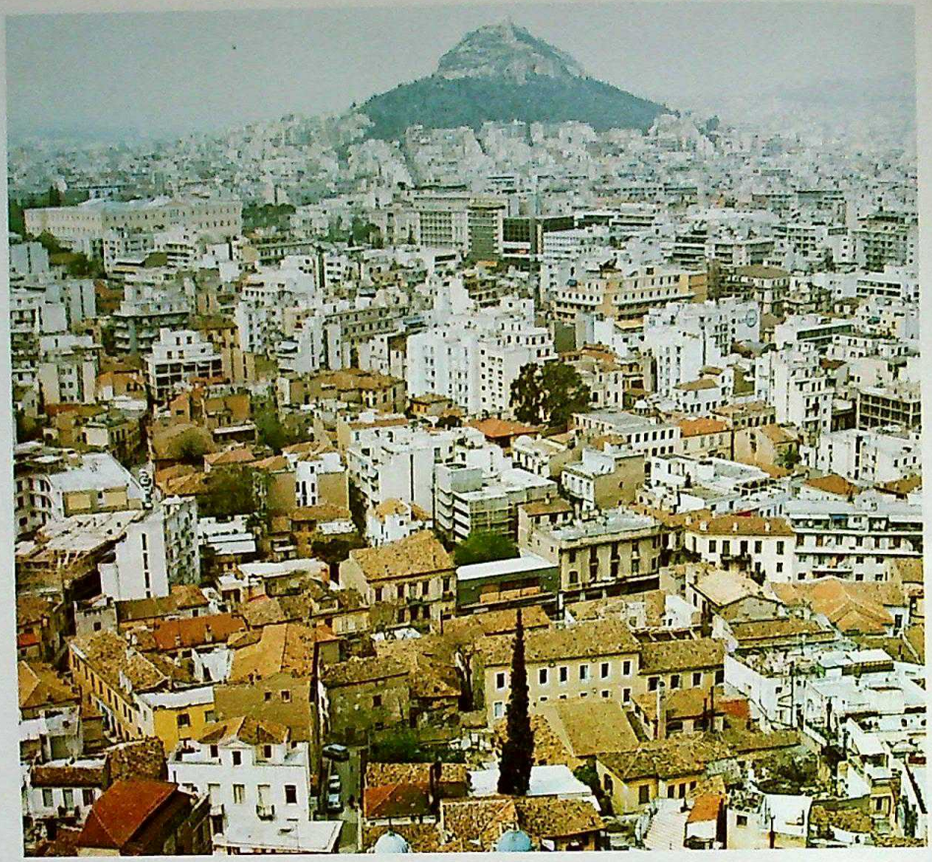
the north-east coast, enclosing the ancient port of Genoa (Genova; 183,000). In the east is the small, independent republic of San Marino (population only about 19,000). In the south the Apennines broaden. On their western flanks are hilly regions with cultivated valleys and fertile river basins. The basin of the River Arno contains the beautiful city of Florence (Firenze; 461,000), one of the world's great art centres. The capital, Rome (Roma; 2,833,000), stands on the River Tiber. Within Rome is an independent state, Vatican City, where the Pope resides.

To the south, the coastal plains broaden around the Bay of Naples. Naples (Napoli; 1,222,000) faces Vesuvius, the only active volcano on the European mainland. Vesuvius destroyed the Roman towns of Herculaneum and Pompeii in a famous eruption in AD79. The southern Apennine region is poor and under-developed. Many southern Italians have gone to northern Italy for work or emigrated overseas.

The island of Sicily off the 'toe' of Italy is also poor, although Palermo (658,000) is an industrial centre. In Sicily is the lofty volcano Mount Etna. The tiny Lipari Islands to the north of Sicily include the volcanoes Stromboli and Vulcano. Farther out in the Mediterranean is Sardinia. It is a large rugged island with a few fertile areas.

Greece

Greece is mainly a farming country, and more than half of the people work on farms. Because it is so mountainous, however, only about a third of the land can be cultivated. In recent years Greece has been developing manufacturing industries based mainly on local produce. Although the country lacks minerals, manufactured goods are now the most valuable exports. Tourism, commerce and shipping are also important sources of revenue. In northern Greece lie the important farming regions of Macedonia and Thrace, where grapes, fruits and tobacco are grown. The chief port Salonica (Thessaloníki) is also a leading industrial centre.



The Greek capital, Athens, as viewed from the Acropolis, the flat-topped hill which has such fine ruins as the Parthenon.

Most of Greece is a peninsula which is almost cut in two by the Gulf of Corinth. The northern part of the peninsula has the rugged Pindus Mountains as its backbone. To the east lies the Thessaly Plain. With its mild winters and hot summers, it is an important farming region. This contrasts with the lands to the west where most farmers grow enough food only for their families. North of the Plain is Mount Olympus, Greece's highest peak (2,917 metres, 9,570 feet). In Greek mythology Mt Olympus was the home of the gods. In south-eastern Greece is the capital Athens (Athínai; population 2,540,000), famed for its ancient ruins, such as the Parthenon.

The southern part of the Greek peninsula, Pelopónnisos, contains rugged land, much damaged by soil erosion. Today, great historical sites, such as Sparta, Corinth and Olympia, are mere villages.

The many beautiful Greek islands are dotted around the Aegean and Ionian Seas. They include Crete (Kríti), Rhodes (Ródhos) and Corfu (Kérkira). The largest, Crete, has a narrow, northern coastal plain where olives, wheat and wines are grown. It is the site of Knossos, centre of one of the earliest Mediterranean civilizations.

European Turkey

A small part of Turkey lies in Europe. The boundary between European and Asian Turkey is the waterway which includes the Bosphorus, the Sea of Marmara and the Dardanelles Strait. The chief city, Istanbul (population 2,132,000), lies on both sides of the Bosphorus, now bridged there by a suspension bridge. Inland, European Turkey is backward. Farming is the chief activity.

Malta

Malta is the largest of a group of islands in the Mediterranean, south of Sicily. They have formed an independent country since 1964. Valletta (population 15,000), the capital, has important dockyards. Farming and fishing are important, as is tourism.

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EASTERN EUROPE

Apart from the German Democratic Republic, or DDR (East Germany), seven other countries in Eastern Europe have communist governments. From north to south, they are Poland, Czechoslovakia, Hungary, Romania, Yugoslavia, Bulgaria and Albania. These countries form a continuous bloc separating the USSR from the countries of Western Europe.

Eastern Europe came under communist influence after World War 2. But today only Bulgaria seems to be completely under Russian domination. Poland, Czechoslovakia, Hungary and Romania have all had differences with the USSR. Yugoslavia has followed independent policies since 1948. Since the late 1950s, Albania has allied itself with China.

Poland

Poland is the largest country in Eastern Europe. Its boundaries have changed several times in the last 200 years. Twice (in 1795 and 1939) it completely disappeared from the map. Its present boundaries were drawn up in 1945.

In the north Poland borders the Baltic Sea. Most of the country is a vast plain, largely covered by deposits left behind after the Ice Age. The Baltic coast is fringed by sand dunes. The most important ports are Gdańsk (Danzig), Gdynia and Szczecin (Stettin). Gdańsk and Gdynia handle goods from the lowland basin of the River Vistula (Wisła). The Vistula is Poland's chief river. Poland's capital city Warsaw (Warszawa; population 1,388,000) stands on the Vistula inland. It is an important historical and

Left: The market square in Krakow, in southern Poland.
Below: Fertile farmland in the foothills of the High Tatra, part of the Carpathian Mountain range on the Slovakia/Polish border.

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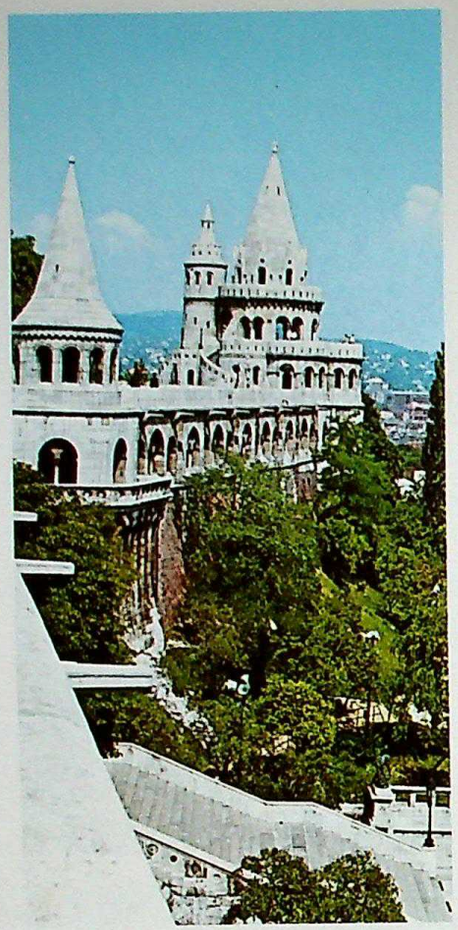
cultural city. Poland's second largest city, Lódź (781,000), lies south-west of Warsaw. It is a major textile and engineering centre.

In the south of Poland is a low plateau, which is the richest farming region in the country. It also contains the important Upper Silesian coalfield. This coalfield lies near the Czechoslovak border in south-central Poland. It has vast reserves of high-quality coal. Major industrial cities in the southern plateau region are Kraków (Cracow), Gliwice (Gleiwitz), Racibórz (Ratibor) and Wrocław (Breslau). In the south-east the plateau rises to the forested Carpathian Mountains.

Before 1939 Poland was mainly a farming country, but today less than three out of every ten people work in agriculture. Since 1945 coal, copper and other minerals have been mined on a large scale. Coal, lignite and coke are leading exports. Among the industries the textile, chemical, papermaking, shipbuilding and iron and steel industries are the most important. All industries are owned by the nation.

However, the communists have failed to bring agriculture under government control. More than four-fifths of the farmland is still privately owned. The remainder is made up of state farms and *collectives* (co-operative farms). In most other communist countries, collectives are of prime importance. The chief farm products are cereals (especially rye), potatoes and sugar beet. Livestock farming is also important.



The Fisherman's Bastion, in Budapest, Hungary's beautiful capital city on the River Danube.

Czechoslovakia

Czechoslovakia is a landlocked country containing two main groups of people. The Czechs live in the west, in the provinces of Bohemia and Moravia. The Slovaks live in the east, in Slovakia. The Czechs outnumber the Slovaks by about 3 to 1.

Bohemia is a mainly highland region, but it contains the rich farming basin of the River Elbe. This basin produces cereals, sugar beet and hops. Bohemia contains many mineral deposits, especially in the Erzgebirge region in the north-west. In parts Bohemia is highly industrialized. It is in fact Czechoslovakia's most densely populated area. Prague (Praha; population 1,090,000) is the country's capital and a great manufacturing centre. It lies on the River Vltava in the centre of Bohemia. Plzeň, to the south-west, has one of the largest car factories in Eastern Europe.

Moravia, in central Czechoslovakia, is a mainly lowland region with much fertile farmland. In the north around Ostrava, it touches the Upper Silesian coalfield. Brno (population 354,000) and Ostrava (291,000) are major manufacturing centres. But in general Moravia is less industrialized than Bohemia. Slovakia is a highland region where farming and forestry are important. Bratislava (population 325,000), a river port on the Danube, is the chief city.

Since 1945 Czechoslovakia has concentrated on developing state-owned manufacturing industries. The proportion of people working on farms has gradually decreased to about 15 out of every 100. The country's chief exports are manufactured goods. Most farmland consists of large collectives and state farms.

Hungary

Hungary is made up largely of an inland basin containing the valleys of the River Danube and its tributaries. In the north-west a fertile, hilly area called the Little Alföld, produces maize, sugar beet, grapes and wheat. The Bakony Forest ridge separates the Little Alföld from Transdanubia in the south-west and the Great Alföld, or Hungarian Plain, in the east. At the foot of the Bakony Ridge is Lake Balaton, whose area is some 600 square kilometres (230 square miles). It is the largest lake in central Europe.

Transdanubia is a farming region which contains Hungary's only important coalfield, near Pécs. Budapest (population 2,039,000) stands on the Danube in the north-west corner of the Great Alföld. It is Hungary's capital and chief industrial centre. The Great Alföld contains some rich farmland, especially between the Danube and Tisza rivers. Vineyards flourish on the lower slopes of the northern highlands bordering Czechoslovakia.

Hungary produces various minerals, including bauxite, coal, petroleum and natural gas, and some iron ore. Industrialization has increased since 1945. Today about 36 out of every 100 people work in industry, as opposed to 25 in agriculture. Collectives and state farms raise wheat and other cereals, potatoes, sugar beet and livestock.

Romania

Romania was once a Roman province, and its language comes from Latin. It is rich in mineral resources, and its soils are generally fertile, but it is still an under-developed country. However, manufacturing is becoming more important. Manufactured

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Lake Balaton, in western Hungary, is the largest lake in central Europe. Some 80 km long and up to 15 km wide, it is one of Hungary's main resort areas.

goods have begun to replace farm and forest products as the chief exports.

The heart of Romania is Transylvania, which consists of a central plateau surrounded by mountains. In the east are the Carpathian Mountains; in the south, the Transylvanian Alps; and in the west, the Bihor Mountains. Forests of beech and oak cover much of Transylvania, but farming is important in the river valleys. The region has many mineral reserves which are still under-exploited.

Along Romania's western border are plains which are an extension of the great Hungarian Plain. They contain Romania's best farmland. The Moldavian Plains in the east and the Wallachian Plains in the south are also important farming regions. The Wallachian Plains in addition contain valuable petroleum deposits. Romania's capital Bucharest (Bucureşti; population 1,529,000) lies on the southern plains. Separating the plains from the Black Sea coast is a low limestone plateau called Dobruja. Constanţa is the country's main port.

A large proportion of the Romanian people still work on farms, which are mainly collectives or state-owned. The chief crops are wheat and other cereals, potatoes, sunflower seeds and sugar beet. The chief minerals are petroleum and natural gas, salt, coal, iron ore and copper. Manufacturing industries are varied.

Yugoslavia

As in most other East European countries, Yugoslavia still depends largely on farming. But mining has been increasing in importance. The development of hydroelectric power has helped the growth of manufacturing.

The coastlands of Yugoslavia (called Dalmatia) consist of mountain ranges, which run parallel to the coast. In the past the coastline has sunk, and the sea has filled the coastal valleys. A network of long narrow islands and large harbours has resulted. The hot, sunny Mediterranean climate has made the Dalmatian coast a tourist attraction. Fishing and the cultivation of such crops as figs, grapes, olives and wheat are the other main occupations. But there is little good agricultural land.

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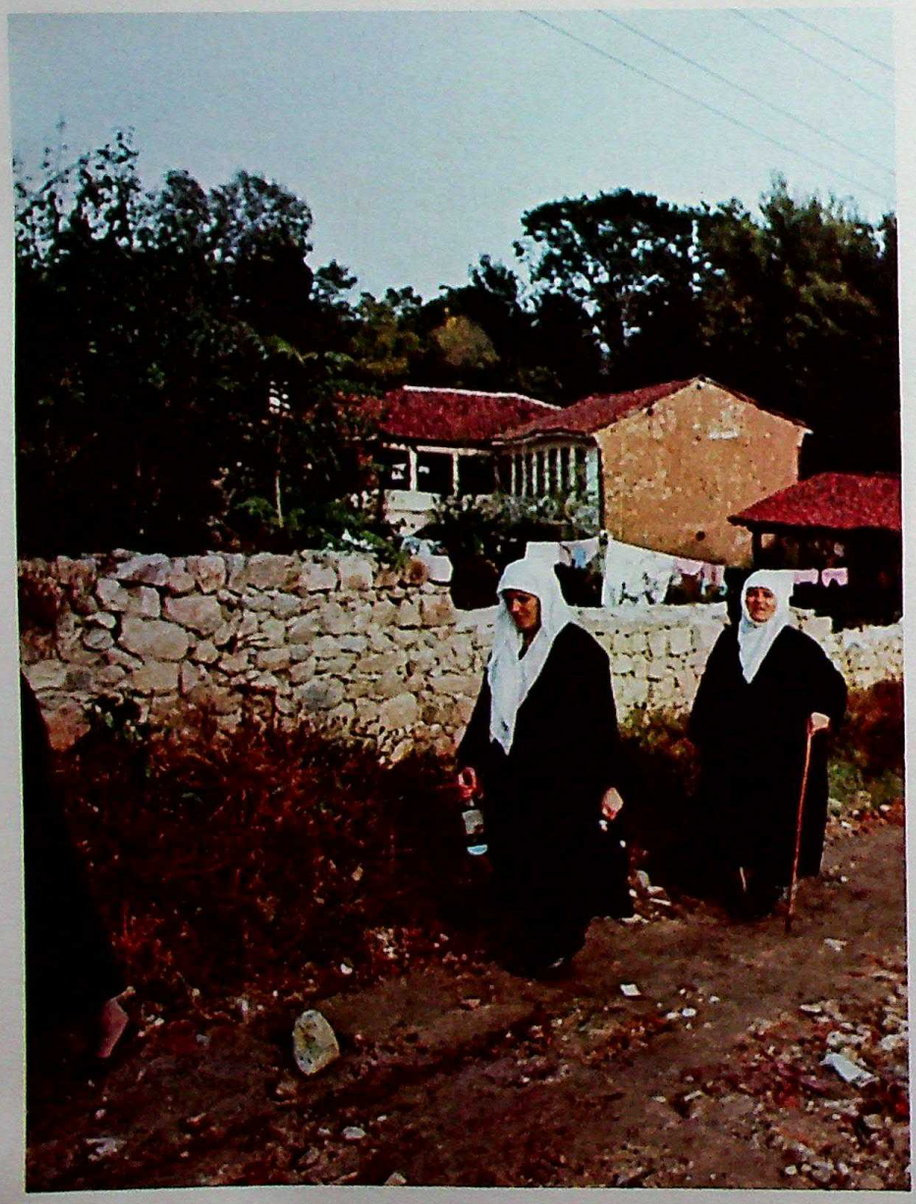
Inland the Dinaric Alps are composed largely of bare limestone. Further inland the mountains and hills are used for forestry, and livestock is raised. Beyond lie the interior plains, which have a continental climate with cold winters. The plains contain rich farmland, where maize and wheat are grown. The capital Belgrade (Beograd; population 1,204,000), and the second city Zagreb (602,000), both lie on the interior plains.

Only two-fifths of the land in Yugoslavia can be cultivated. But nearly half of the population live by farming. Some of the country's industries are based on farm products. However, the country also has rich mineral resources. In recent years iron and steel, machinery and transport equipment industries have been built up. Since 1948 Yugoslavia has not allied itself with either the USSR or China. Instead it has pursued an independent policy. It trades widely with the West.

Bulgaria

Since 1945 Bulgaria has been closely linked with the USSR, which now accounts for more than half of its trade. Although still a poor country, Bulgaria's mining and manufacturing industries have been expanding. More than twice as many people work in industry as in agriculture. Bulgaria's minerals include petroleum, lignite, iron ore and copper. Industries produce cement, iron and steel, chemicals and textiles.



These Bulgarian women are of Turkish extraction and, like most Turks, are Muslims.

The Balkan Mountains cover much of northern Bulgaria. In the far north, however, the mountains descend to a fertile lowland bordering the River Danube. In the south-west the Rhodope Mountains rise to nearly 3,048 metres (10,000 feet). The people of the highland area are poor.

The central lowlands have a pleasant climate and are Bulgaria's most productive region. Among the crops grown are fruits, mulberry trees (for rearing silkworms), sugar beet, tobacco and grapes. The region is also famed for the cultivation of roses. From the petals is made *attar of roses*, which is used in perfume. The Black Sea coastline attracts many holidaymakers.

Bulgaria's capital, Sofia (Sofija; population 946,000), lies in a fertile basin in the western highlands. It is a route centre, with some manufacturing industries.

Albania

Albania is the smallest of the communist Eastern European nations. Two-thirds of the country is more than 915 metres (3,000 feet) above sea level. Forests cover nearly half of the country. The main farming areas are the coastlands and the interior basins. Cereals, mulberry trees, olives and grapes are grown.

Before 1939 Albania was almost entirely a farming country. After 1945 the USSR helped Albania develop its mineral resources. In the late 1950s Albania broke with the USSR and allied itself with communist China. China helped Albania to modernize and develop manufacturing industries. Today Albania produces chromium, copper, coal and petroleum. Its industries include chemical, engineering and iron and steel industries. However, despite these changes, most Albanians are still engaged in farming.

About seven-tenths of Albania's trade is with China. Most of the rest is with other communist countries, but not including the USSR. Albania's capital, Tirana (Tiranë), has a population of 175,000.

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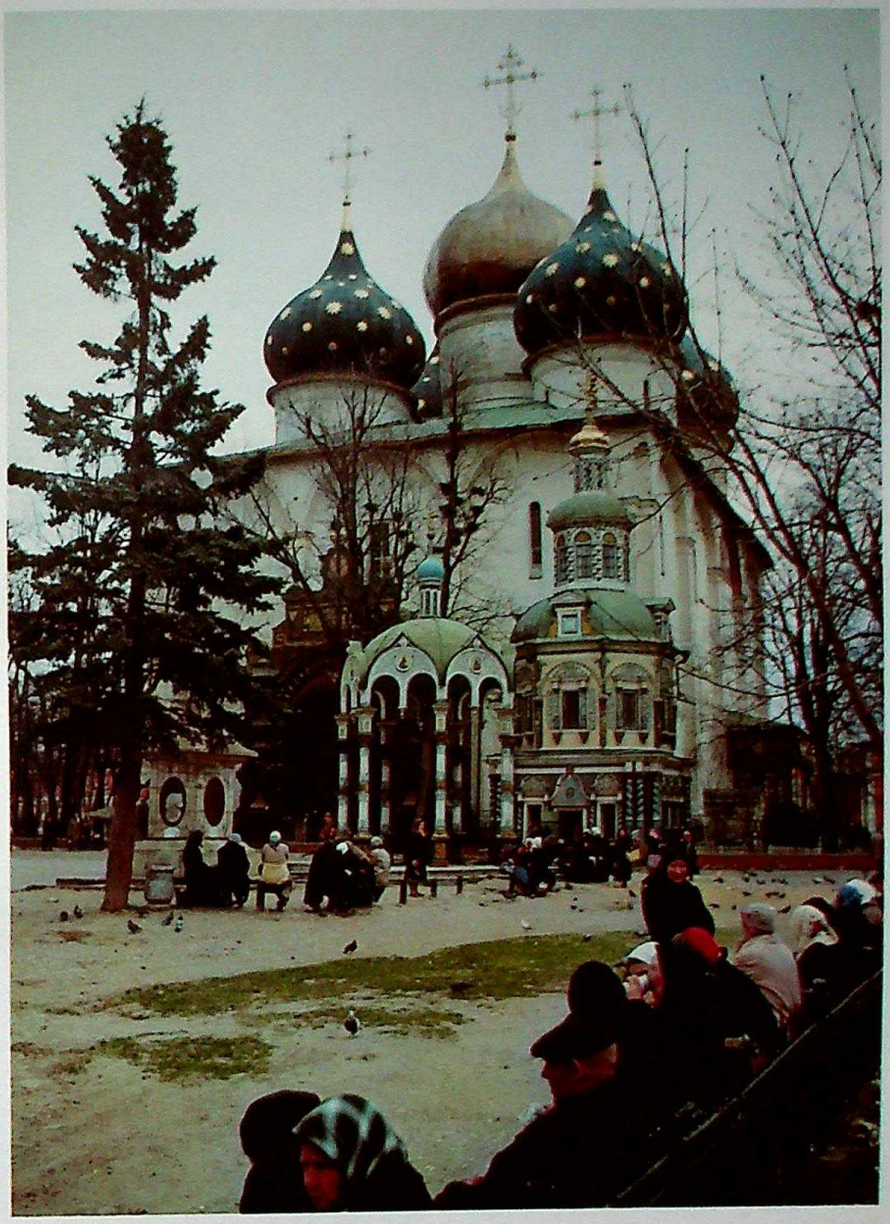
EUROPEAN RUSSIA

Russia, or the Union of Soviet Socialist Republics (USSR), is the world's largest country. It lies partly in Europe and partly in Asia. The boundary between the two parts is formed by the north-south Ural Mountains, the Ural River and the Caspian Sea.

European Russia makes up more than half of Europe's area, but it forms less than a quarter of the country as a whole. European Russia is the most developed part, and about three-quarters of the USSR's popula- live there. European Russia contains most of the country's industrial centres and much of its best farmland. It also contains most of the largest cities, including the capital Moscow (Moskva; population 7,528,000) and Leningrad (4,243,000).

In the 1800s Russia was a poor, under-developed country ruled by a czar (king). In 1917 a revolution occurred, and the communist party seized power. The communists' methods have often been cruel and ruthless. But under their rule Russia has grown to become one of the world's greatest powers.

Russia is divided into 15 areas called *union republics*. Each union republic contains a group of peoples with their own language and culture. Nine complete union republics – Armenia, Azerbaijan, Belorussia, Estonia, Georgia, Latvia, Lithuania, Moldavia and Ukraine – are in European Russia. But the largest area is occupied by the Russian Soviet Federated Socialist Republic (RSFSR). The RSFSR covers about three-quarters of Russia, and sprawls across Europe and Asia. The people of the RSFSR speak Russian and form nearly two-thirds of Russia's population. The other leading groups of people in European Russia are the Ukrainians and the Belorussians, who are Slavic people like the Russians.



This cathedral, at Zagorsk, near Moscow, has the domes typical of Russian religious architecture.

The Russian Plain

Most of European Russia is a vast plain, interrupted by ranges of low, rolling hills. The central Russian upland is mostly below 300 metres (1,000 feet) above sea level. It stretches from the Karelian Shield in the north-west to the Ukrainian uplands in the south-west. The Karelian Shield is an extension of the Baltic Shield. It has been worn almost level by the action of glacial ice. The region contains several lakes, including lakes Ladoga and Onega.

The Russian plain west of the central uplands is an extension of the vast North European Plain, which stretches from the Netherlands to Poland. East of the central uplands is the Central Russian Plain, which extends to the Ural range. In the south-east, the central Russian plain merges into the Turanian Lowlands around the northern part of the Caspian Sea. The Caspian Sea is a salt lake lying below sea level. It has been shrinking for hundreds of years. The lowlands around it are unsuitable for farming because the soil is too salty.

Mountains and Rivers

The Ural mountain range is about 240 kilometres (150 miles) long. The highest point, Gora Narodnaya, rises 1,894 metres (6,214

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feet) above sea level. But most of the range is below 900 metres (3,000 feet) above sea level.

In the south-eastern part of European Russia are the Crimean, Caucasus and Armenian mountains. The short Crimean range, on the southern part of the Crimean peninsula, rises steeply from the Black Sea to more than 1,500 metres (5,000 feet) above sea level. The scenic Caucasus Mountains run between the Black Sea and the Caspian Sea. These folded mountains contain blocks of volcanic rocks. Mt Elbrus is a volcanic peak rising to 5,629 metres (18,468 feet). It is the highest point in Europe. To the south of the Caucasus, the Armenian Mountains straddle the frontiers with Iran and Turkey. Their highest peak, Mt Ararat (5,165 metres, 16,946 feet), is in Turkey.

Several long rivers drain European Russia. The great Volga River, Europe's longest, flows about 3,860 km (2,400 miles) before emptying into the Caspian Sea. It forms with its tributaries and canals the country's most important waterway. It is linked to the Baltic by the 360-km (225-mile) Volga-Baltic canal.

In the south-east, the Dniester, Bug and Dnieper flow into the Black Sea. The Don flows into the sea of Azov, which is linked to the Black Sea. Major rivers flowing northwards are the Dvina and the Pechora. Russia's rivers freeze over for a period every winter.

Climate

Most of European Russia lies far from the moderating effects of the oceans, and the region has an extreme, continental climate. Although temperatures gradually increase to the south, practically all of European Russia has bitterly cold winters, with temperatures below freezing point. The southern shores of the Crimean peninsula are an exception.

In the far north, around the Arctic Circle, summer temperatures are usually less than 12°C (54°F). Winter temperatures plummet to an average of −12°C (10°F). South of the Arctic lies the cool, temperate interior. Moscow lies in this region. It has average July temperatures of 18°C (64°F). But in winter temperatures drop to −11°C (13°F). South of Moscow, summers become warmer. For example, Astrakhan on the Caspian Sea has average temperatures of −7°C (19°F) in January and 26°C (78°F) in July.

Most of European Russia has less than 760 millimetres (30 inches) of rain each year. Around the Caspian Sea, however, the rainfall averages less than 250 millimetres (10 inches). The mountains are wetter.

Plant and Animal Life

In the far north of European Russia, the tundra region is too cold for trees. The poor soils are usually waterlogged or frozen. The main plants are mosses, lichens and small bushes. South of the tundra is a vast belt of coniferous forest, containing firs, pines and spruces. The grey, acid soils in this region are called *podzols*. They require lime and manure before they can be farmed successfully. The coniferous forests give way in the south to mixed and deciduous forest zones which extend beyond Moscow.

Inside Russia's largest department store, GUM, which is situated opposite the Kremlin in Moscow.

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Forestry is an important industry in European Russia.

South of the forests is a large belt of almost treeless grassland called *steppe*. The soils of the steppes range from chestnut-brown to black in colour. The black-earth steppe of the Ukraine is the USSR's richest farmland. A semi-desert region surrounds the low-lying Caspian Sea. The mountains in the south have mixed vegetation varying with altitude.

The northern and central forest zones were once rich in wildlife, including bears, deer, ermine, mink and wolves. But many species have become rare because of hunting. Many of the wild animals of the steppes, such as wild horses and antelope, have disappeared.

The giant Kirow turbine factory in Leningrad. Russia is now the second most powerful industrial nation, after the United States.

Economy

Since the revolution of 1917, the communists have aimed at turning Russia into a leading world power. Before 1917 the country was under-developed. Mining and manufacturing lagged behind western European countries and the United States. Farming methods were largely primitive, and yields were low.

Since 1928 the communists have introduced a series of five-year development plans. World War 2 caused a major setback, but since then development has been rapid. Economic planning has been based on state, or public, ownership of mining and industry; and on mixed public and collective (co-operative) ownership in agriculture.

The communists have concentrated most on developing heavy industry. In 1913 more than half of the people worked on farms. Seventy years later only about one-sixth of the working population were engaged in agriculture. More than half of the people now live in cities and towns.

Between 1913 and today Russia's output of coal and iron ore has increased more than 20 times. Vast deposits of petroleum and mineral ores have been discovered and exploited. Russia is the world's largest producer of coal, with an annual production of more than 630 million tonnes.

It is a major petroleum producer, with an annual output of some 2,600 million barrels (about 400,000 million litres). Outside the Middle East only the United States has a greater output. It now exports both petroleum and natural gas to other East European countries. Russia is also second only to the United States in production of natural gas.

Russia leads the world in its production of chromium, iron, lead and manganese ores. It is also a major producer of asbestos, gold, nickel, phosphates and sulphur. Russia's steel industry now rivals those of the United States and Japan.

About three-quarters of Russia's electric power comes from conventional steam power stations. Most of the remainder is produced by hydroelectricity. Russia has some of the world's largest hydroelectric power stations, although the biggest ones are found in Asian Russia. It also has the world's greatest hydroelectric power potential. A little electricity is produced from nuclear power stations.

Agriculture, however, has not progressed as much as mining and industry. Russia still has to import large amounts of food, especially after crop failures caused by droughts. To achieve their aim, the Russian people have been forced to make many sacrifices. They still have a lower standard of living than most people in Western Europe and the United States.

Russia's economic development has been hampered by the sheer size of the country. Because distances are so great, vast road, railway and canal networks have had to be developed to transport materials.

Agriculture: Before 1917 only about one-twentieth of the land area of Russia was cultivated. The farmland was divided between large estates owned by rich aristocrats and very small peasant farms. Today twice the area is under cultivation. New farming techniques have been introduced; large areas of swampland have been drained; and many dry regions have been irrigated.

Most of the cultivated land is now farmed either by collectives (*kolkhozy*) or by state farms (*sovkhozy*). On collectives the workers share the produce and do not receive wages. Each household can, however, farm its own plot of land. The government supplies the collectives with tractors, machinery and seeds. On state farms workers are paid wages and do not share the produce.

European Russia contains much of the best farmland in the

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country. In the far north the tundra is unsuitable for farming. Farther south is the northern coniferous forest belt. In parts of this region the rather poor soils have been improved by fertilizers, and oats, rye and potatoes are grown. Dairy farming becomes important as we go farther south. In the deciduous forest belt flax, oats and rye, and increasing amounts of wheat and sugar beet are being produced. The richest farming region of all is the black-earth Ukrainian steppe, where wheat, above all, and sugar beet are the chief crops. The southern Crimea produces Mediterranean-type fruits. The Caucasus region, called Transcaucasia, produces cotton, fruit, silk, tea and tobacco. The dry steppe-land north of the Caspian Sea has irrigated areas which produce cotton, rice and wheat.

Russia has about 106 million cattle. Dairy farming is most important in the temperate north, and beef farming in the Ukrainian steppes. Pigs thrive in the west, while sheep are more important in the drier east.

Mining: Russia has vast mineral resources. It is thought to have over half of the world's reserves of coal and nearly half of the reserves of iron ore. It also has more than a tenth of the world's petroleum reserves – more than any country outside the Middle East. Many other mineral ores and chemicals are mined in both the European and Asian part of Russia. Most of the mining industry, however, is in European Russia.

The leading coalfield is the Donbas region around Donetz in the Ukraine. Forty years ago, this coalfield produced practically all of the country's coal. Today there are also important coalfields in the Ural Mountains; around Moscow; and in the Asian part of Russia.

The Baku area in Transcaucasia was the first major petroleum-producing area. Another rich petroleum zone lies between the Volga River and the Ural Mountains. This region contains several large cities, including Kujbyšev and Ufa.

Russia's iron-ore production is centred on mines around Krivoj Rog in the Ukraine. Large quantities are also mined in the Ural Mountains and at Kerč in the Crimea.

Manufacturing: The greatest changes of all in the USSR over the past 30 years have taken place in manufacturing. All of the large cities in European Russia have their own industries. But most manufacturing takes place in five main areas: the Moscow region, the Ukraine, the Ural Mountains, Transcaucasia, and the Leningrad region.

The large industrial region around Moscow is most important. It includes many industrial cities and towns, including Moscow, Gor'kij, Voronež and Jaroslavl'. This region has major textile, metal and chemical industries. The Ukraine has four main manufacturing centres: the Donbas coalfield; the Dnepropetrovsk area; the Krivoj Rog iron-ore area; and a region around the shores of the Sea of Azov, which includes the cities of Rostov and Zadanov. Kijev, Char'kov and Volgograd are other important industrial cities.

The Urals are rich in minerals, and leading manufacturing cities in the area include Sverdlovsk and Magnitogorsk. The main industrial city in the petroleum-producing Transcaucasia region is Baku. The large industrial region around Leningrad has grown up because Leningrad is Russia's chief port. Shipbuilding is a major industry there.

The village of Tchafut Kale, in the Crimea, a sunny peninsula that juts into the Black Sea.

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ASIA

INTRODUCTION

Asia is the biggest continent in area and in population. One-third of the world's land is in Asia (44,339,377 square kilometres, 17,119,528 square miles), and three-fifths of its people (2,300 million in 1975). Asia has been the home of many of the world's great civilizations, and the source of all major religions.

Asia extends from the Arctic to the Equator. West to east, it stretches nearly half-way round the world. Over one-third of all Asians are Chinese; nearly one-third live in the Indian sub-continent. The remaining third of Asia's people live in about 40 different countries.

Some of the millions of South Vietnamese made homeless by the Vietnam War in the early 1970s.

Early Civilizations

No-one knows when men first lived in Asia, but it was certainly over a million years ago. Over 30,000 years ago Asia was dominated by people belonging to two of the world's three or four main races. Northern and eastern Asia was inhabited by *Mongoloid* peoples. Some of these were already trekking overland into the Americas. Southern and south-west Asia were peopled by *Caucasoids*, a similar race to the modern Europeans.

The earliest known civilizations in Asia began to emerge about 6,000 years ago. They were the Sumerian, and the Indus Valley civilizations. About 3,500 years ago other civilizations were flourishing, including the Hittite, the Babylonian and the Chinese. The Chinese civilization has now existed for longer than any other civilization. A great civilization began in Persia (now Iran) about 3,000 years ago. It was destroyed in the 300s BC by a Greek army led by Alexander the Great, who marched through Persia into India. However, after Alexander's death in 323 BC, his Asian conquests melted away. Apart from slight overland contact through trade routes, and the battles fought by the Crusaders (AD 1096–1291) for Palestine, Asia remained free of invasion from Europe for another 1,800 years.

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The Europeans in Asia

Few Europeans travelled to Asia until 500 years ago. Of those who did, none is more famous than Marco Polo. He set off from Venice in Italy with his father and his uncle in about 1260. Polo lived many years in China, working for Kublai Khan. Kublai was the Mongol leader who had conquered all China by 1279. Other large bands of nomadic Mongols swept westwards through Asia into the heart of Europe in the 1300s.

The Mongols were divided into many tribes, including Tartars and Turks. As each tribe in turn pushed westwards, it drove earlier tribes farther west. The Mongol invasions cut the overland trade routes between Asia and Europe.

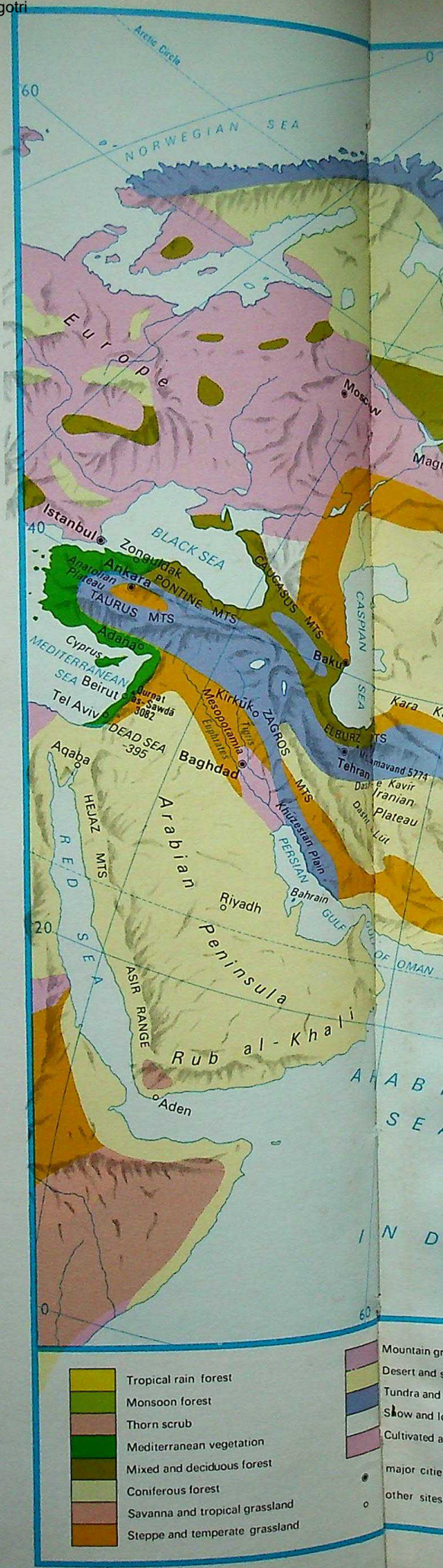
By the 1400s there was a great demand among rich people in Europe for the silks, embroidered cloths, spices and other luxuries that could be bought in Asia. European merchants risked sending fleets into unknown seas to transport the wares of Asia to Europe. In 1498 Vasco da Gama's Portuguese fleet rounded Africa and found the route to India.

Other fleets followed. Soon, Portuguese, Spanish, English, Dutch and French ships were sailing regular routes to Asia. When they heard that the world was round like a ball, some sailors tried to find the east by sailing west, like Christopher Columbus.

ASIA

Country	Area Sq. Km.	Population 1975 est.	Capital
Afghanistan	647,497	19,240,000	Kabul
Bahrain	622	249,000	Manama
Bangladesh	142,806	78,000,000	Dacca
Bhutan	47,000	1,201,000	Thimbu
Brunei*	5,765	145,000	Bandar Seri Begawan
Burma	678,033	31,247,000	Rangoon
Cambodia	181,035	6,546,000	Phom Penh
China	9,596,961	829,800,000	Peking
Cyprus	9,251	665,100	Nicosia
Hong Kong	1,034	4,290,000	Victoria
India	3,280,483	619,000,000	New Delhi
Indonesia	1,491,564	139,140,000	Jakarta
Iran	1,648,000	33,131,000	Teheran
Iraq	434,924	11,100,000	Baghdad
Israel	20,700	3,330,000	Jerusalem
Japan	370,070	109,362,000	Tokyo
Korea, North	120,538	15,949,000	Pyongyang
Korea, South	98,477	35,859,000	Seoul
Kuwait	17,818	1,111,000	Kuwait
Laos	236,800	3,335,000	Vientiane
Lebanon	10,400	3,216,000	Beirut
Macao	16	260,000	Macao
Malaysia†	333,473	11,710,000	Kuala Lumpur
Maldives	298	118,000	Malé
Mongolia	1,565,000	1,492,000	Ulan Bator
Nepal	140,797	11,503,000	Kathmundu

(table continued overleaf)



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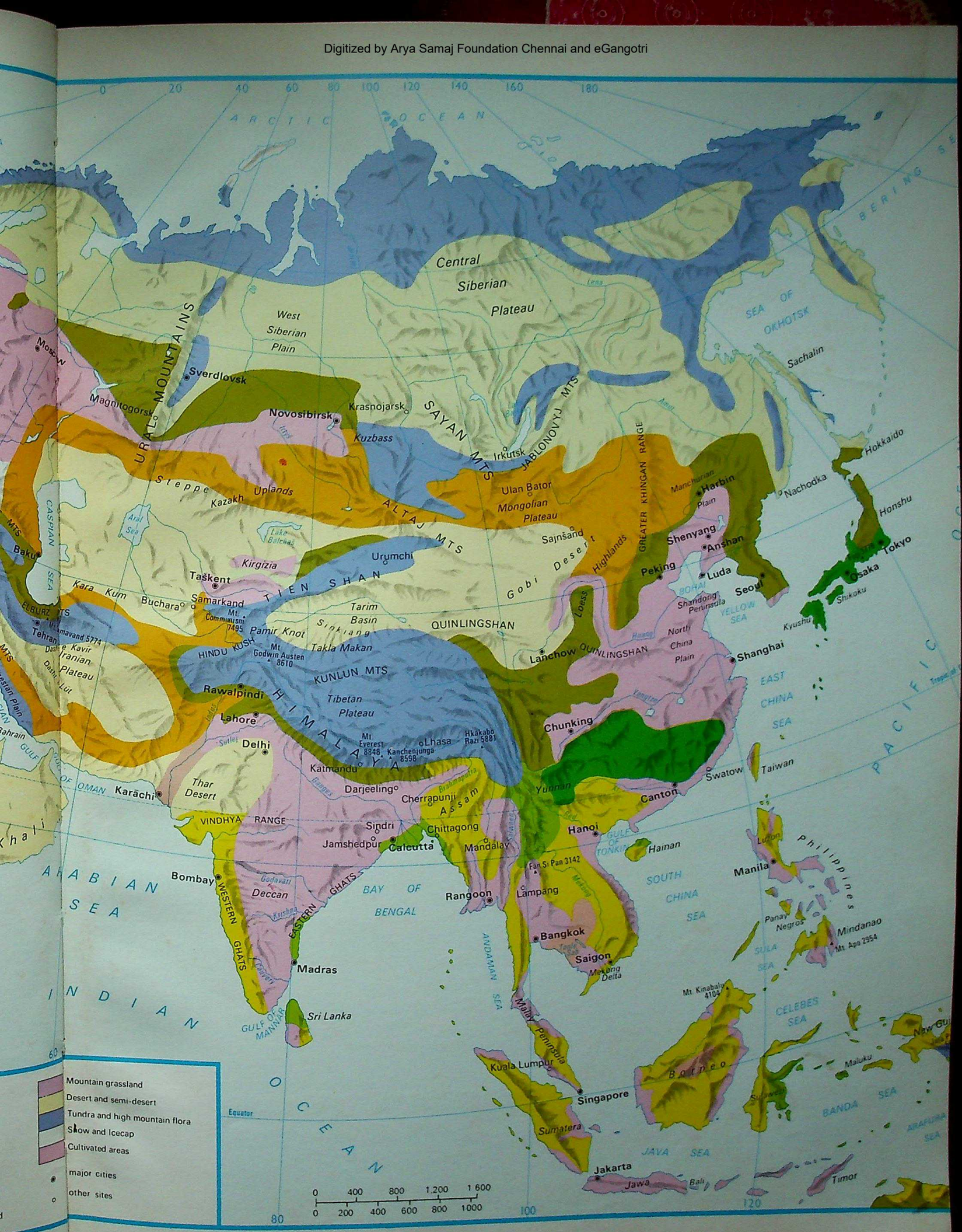

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Country	Area Sq. Km.	Population 1975 est.	Capital
Oman	212,457	798,000	Muscat
Pakistan	946,719	70,241,000	Islamabad
Philippines	300,000	45,277,000	Quezon City
Qatar	22,014	101,000	Doha
Saudi Arabia	2,149,690	8,843,000	Riyadh
Singapore	581	2,279,000	Singapore
Sri Lanka	65,610	14,000,000	Colombo
Syria	185,180	6,663,000	Damascus
Taiwan‡	35,983	14,833,000	Taipei
Thailand	514,000	39,249,000	Bangkok
Timor, East	14,925	670,000	Dili
Turkey (in Asia)	756,953	36,967,000	Ankara
USSR (in Asia)	16,831,000	62,576,000	Moscow
United Arab Emirates	83,600	265,000	Abu Dhabi
Vietnam, North	158,785	23,744,000	Hanoi
Vietnam, South	173,809	20,200,000	Saigon
Yemen, North	195,000	5,300,000	Sana'a
Yemen, South	287,683	1,336,000	Ash Sha'b (Aden)

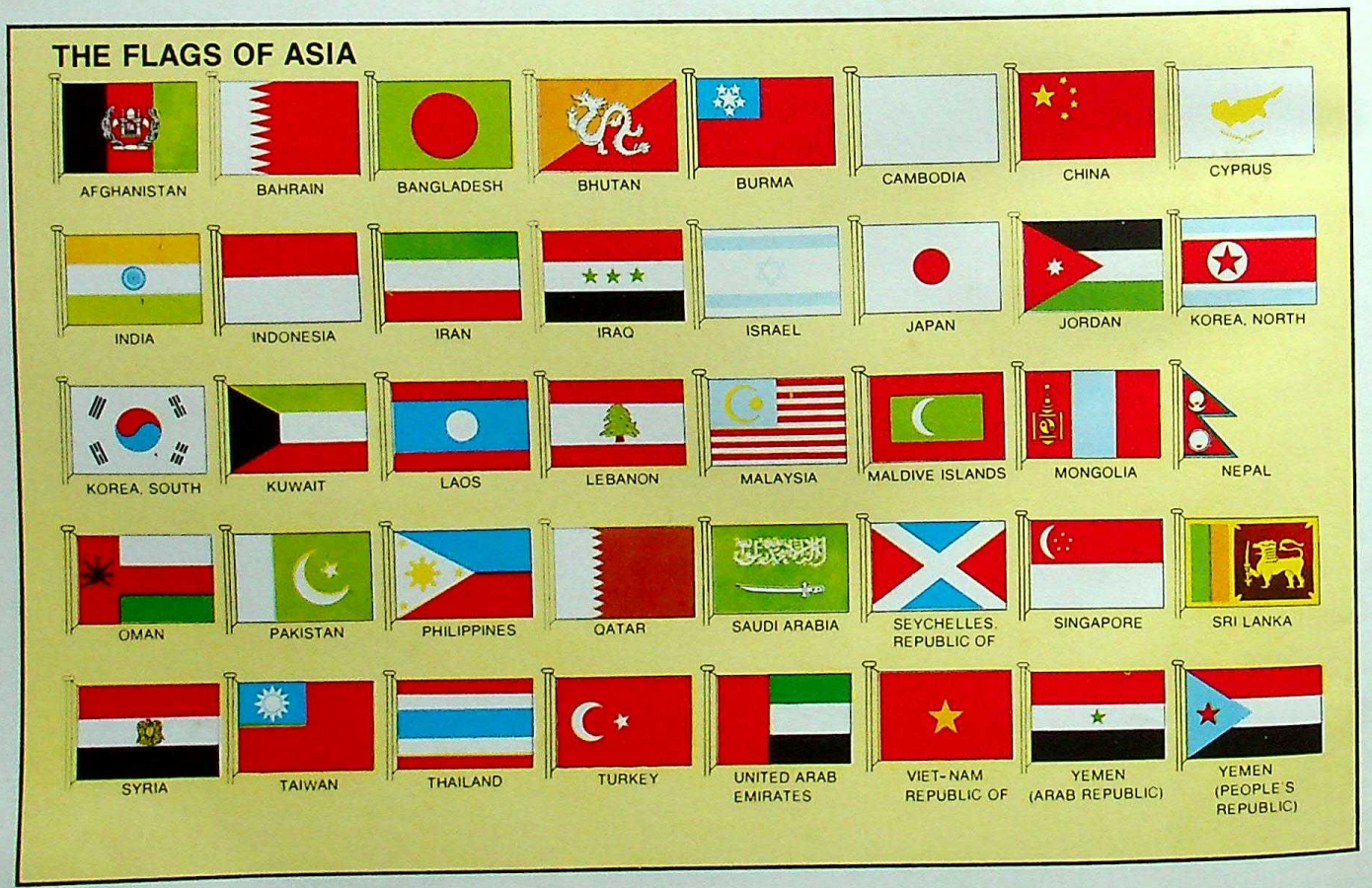
*Brunei is a British Protected state.
†Malaya (independent in 1957) joined Sabah, Sarawak and Singapore to form Malaysia in 1963. Singapore broke away in 1965.
‡Taiwan ceased to be occupied by Japan in 1945, but was not reunited to China.

Powerful European trading stations grew up along the coasts of Asia. The most important trading company was the English East India Company. It held lands from Arabia to Malaya, especially in India. It kept its own armies and set up its own governments. By 1900 Europeans ruled most of Asia. The United States took the Philippines from Spain in 1898. From Muscovy (the area around Moscow) the Russians conquered northern and central Asia. Only Japan, Turkey and Thailand escaped occupation by the Europeans.

Independent Asia

The first signs of change came in 1905 when the Japanese defeated Russia – a European country – in war. In the 1900s the people of Asia began to demand independence. The two world wars speeded events.

When the Australians left Papua-New Guinea in 1975, almost all Asia was independent. China was again a great power, and Japan had become the world's third most powerful industrial nation.



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RELIGIONS OF ASIA

The driving force of the Indians, Chinese and Arabs was their religions. Since these have spread throughout most of Asia, the best way to understand the peoples of Asia today is to look at these religions.

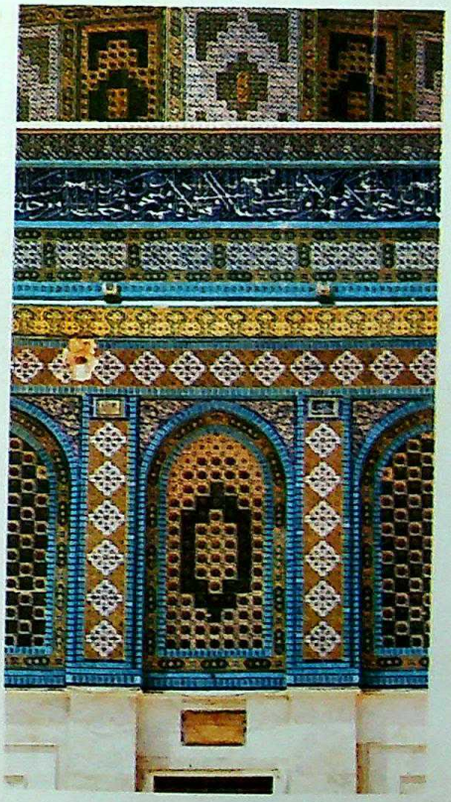
India

Hinduism, the principal belief of present-day India, developed from an extremely old religion. It was given new force by the Aryans, a Caucasoid people who began to conquer northern India about 4,000 years ago. Hinduism's many gods can be seen in the impressive, sculptured temples of India. However, many modern Hindus regard these as only different aspects of one God. The great literature of Hinduism includes the *Ramayana* – a popular source of ideas for poems, folktales, sculptures, paintings and even films. Hinduism has over 500 million followers.

Buddhism developed from the teachings of Siddhartha Gautama, who became known as *Buddha* ('Enlightened One'). He was born a Hindu, on the Indian–Nepalese border, about 2,500 years ago. Buddha taught that people should follow a 'Middle Way' in life. They should avoid too much luxury and pleasure, but need not seek a life of great hardship as many Hindu holy men did. However, said Buddha, all living was suffering, so the best thing to do was to escape from life. This was difficult because at death people were *reincarnated* (reborn). Sometimes they were reborn in better circumstances and sometimes as animals or insects. The only way to escape from this cycle of death and rebirth was by earning merit through good deeds in life.

Buddhism almost died out in India over 1,000 years ago, but it still flourishes in Japan and parts of South-East Asia. It has nearly 300 million followers. Buddhism has developed distinct styles of painting. The huge statues of Buddha in the temples are often plated with gold.

Above: An elaborately decorated Hindu shrine in Madras. Most Indians are Hindus.
Below: The exquisite decoration on the Dome on the Rock, a famous Muslim shrine in Jerusalem.



Sikhism developed in about AD 1500, in what is now the Punjab state of India. It was begun by Guru Nanak, who tried to combine what he believed to be the best features of Hinduism and Islam. Sikhs number about 10 millions. The Golden Temple in Amritsar, in the Punjab, is their greatest shrine.

China

Taoism developed from a mixture of magic and philosophy. Its holy book, the *Tao-te-ching* (*The Way of Life*) is said to have been written by Lao-tzu. Taoists consider the workings of Nature to be more important than the wisdom of learned men.

Confucianism developed from the teachings of Confucius, a Chinese scholar who lived at about the same time as Buddha. Confucius believed in observing old customs and traditions, and in everyone keeping his rank and status. He taught people to honour their parents and ancestors. Confucius was declared to be a god in China as late as 1908, but the communist government has attacked his teachings.

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Buddhism came to China from India. In the past, almost every Chinese was Taoist, Confucianist and Buddhist at the same time. Under communist rule, religion in China is gradually disappearing. Nevertheless it still influences the Chinese attitude to life.

A Greek Orthodox priest painting an icon at the monastery of Saint Barnabus, in Cyprus.

South-West Asia

Judaism (the religion of the Jews) is very old, like Hinduism. Jews have faith in one God and they worship in synagogues. The traditional founders of Judaism are Abraham and Moses. Only one fifth of the world's 15 million Judaists live in Israel.

Christianity. Although Jesus of Nazareth, the founder of Christianity, and his disciples taught in Palestine, it was in Europe and the countries settled by Europeans that Christianity had its greatest lasting success. However the Spaniards took Christianity to the Philippines, where it is still the main religion. But in Asia generally, relatively few people are Christian.

Islam, whose followers are called Muslims, came into being in AD 622. In that year Muhammed (later called the Prophet) fled from Mecca in Arabia to the nearby city of Medina. Muhammed said that *Allah* (God) had revealed messages to him. These *revelations* were written down in the *Koran* – the holy book of Islam.

Muslims must follow the 'five pillars of Islam'. They must have faith in Allah and his Prophet, Muhammed. They must pray facing Mecca five times each day, and give alms to the poor. They must fast during *Ramadan* (the holy month of the Muslim year). And they must try to make the *hajj* (pilgrimage) to the holy city of Mecca.

Muslims pray directly to God, without priests. They can pray anywhere, but usually go to a *mosque*. Mosques are easily recognized by their low domes and tall *minarets* (towers). From Arabia, Islam spread into northern Africa and eastwards to Indonesia. Today it has nearly 600 million followers. Most Muslim art emphasizes geometrical design. Muhammed discouraged pictures of people and animals.

Japanese theatre is very stylized. The Kabuki theatre (below) features dance, song and mime.

Japan

Shinto. Japan was heavily influenced by Chinese civilization, but developed its own distinct religion, *Shinto*. Shintoists believe in a vast number of *kami* (spirits) which include dead emperors, nature gods, heroes, trees, rivers, mountains and even happiness or a smile. Most Japanese homes have a Shinto shrine, and often a Buddhist one too. Shinto has not spread outside Japan.

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LAND REGIONS & CLIMATE

The mighty Himalayas soar to 8,848 m at Mt Everest, the highest mountain in the world.

Natural Regions

The vast land area of Asia – more than 44 million square kilometres (over 17 million square miles) – can be divided up into six main geographical regions. The regions are northern, central, eastern, southern, south-eastern and south-western Asia. We discuss these regions, their peoples, and their ways of life in more detail in the pages which follow.

Northern Asia comprises the vast thinly populated region of Russia called Siberia. It extends west to east from the Ural Mountains to the Pacific. It stretches north to south from way beyond the Arctic Circle to a series of mountain ranges extending north-east from the Hindu Kush. In area northern Asia covers more than a third of the whole continent, which means that it is bigger than Europe and nearly as big as South America.

Central Asia includes the remote, rugged mountainous and plateau regions of western China, Tibet and Mongolia. They are among the bleakest on Earth.

Eastern Asia includes most of China, the islands of Japan and North and South Korea. It is one of the world's largest centres of population. The region is often called the *Far East*.

South-East Asia includes the lands on the large peninsula between India and China, together with the scattered islands of Indonesia, Borneo, the Philippines and New Guinea. The mainland countries are North and South Vietnam, Laos, Cambodia, Thailand (Siam) and Burma. The mainland extends in the south into a long peninsula, the Malay Peninsula. Malaya, at the tip, forms the main part of Malaysia, which also includes the states of Sabah and Sarawak on Borneo. Also on Borneo is the tiny British-protected state of Brunei. Singapore is an island state off the tip of the Malay Peninsula. Vietnam, Laos and Cambodia were once known as Indo-China.

Southern Asia is bounded in the north by the towering Himalayas. Most of this region is occupied by India. In fact it is often called the Indian sub-continent. In the mountainous north-east are the countries of Nepal and Bhutan. South of Bhutan is the state of Bangladesh, formerly East Pakistan. In the north-west of the region are Pakistan and Afghanistan. The Jammu and Kashmir region, sandwiched between Pakistan, India and China, has featured in boundary disputes between India and Pakistan for many years.

South-West Asia includes the countries of Iran, Turkey and those on the Arabian Peninsula. These include Saudi Arabia, Iraq, Syria, Jordan, the Lebanon, Israel, Kuwait and numerous sheikdoms around the Persian Gulf. The whole region is often called the *Middle East*. It is a region of dry sandy deserts and is notable for its vast petroleum deposits. It is the most productive oil-producing region in the world, and has more than three-fifths of the world's petroleum reserves.

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The Pamir Knot

One of the most interesting physical features of Asia is the Pamir Knot. This is a very high plateau region on the borders of five countries – Russia, Afghanistan, Pakistan, India and China. On average more than 4,000 metres (13,000 feet) above sea level, it has peaks up to 7,600 metres, 25,000 feet). The highest point in Russia, Mount Communism (7,495 metres, 24,590 feet) lies in this region.

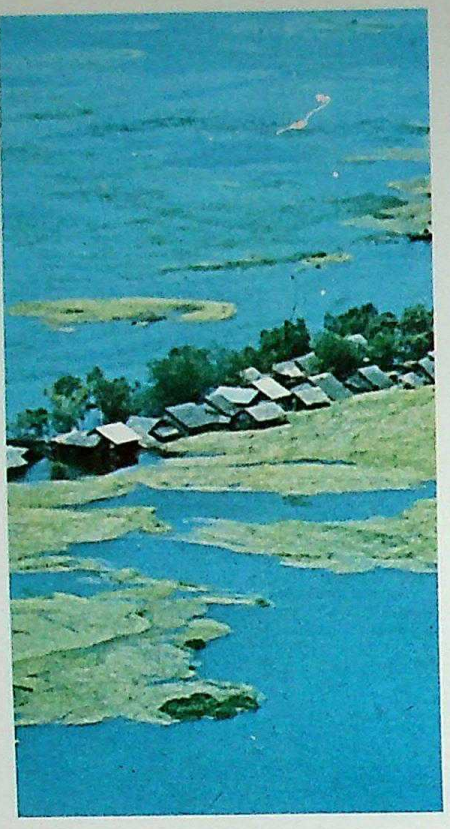
The Pamir Knot is the meeting place of most of the great mountain chains that divide Asia, including the Hindu Kush, the Tien Shan and the mighty Himalaya. Well is it called *Bam i Dunya* – the roof of the world. The Himalaya range has the world's largest peaks – Mount Everest (8,848 metres, 29,028 feet), Mount Godwin Austen, or K2 (8,610 metres, 28,250 feet) and Kanchenjunga (8,598 metres, 28,208 feet).

The Climate

Asia's northern coastline lies well within the Arctic Circle. But its southern shores lie almost entirely in the tropics. The continent comprises the world's largest land mass, bounded on the east by the largest ocean, the Pacific. Asia has the highest mountain range (the Himalaya), and the largest inland sea (the Caspian). These features, together with its system of wind currents, cause the continent to have almost every kind of climate.

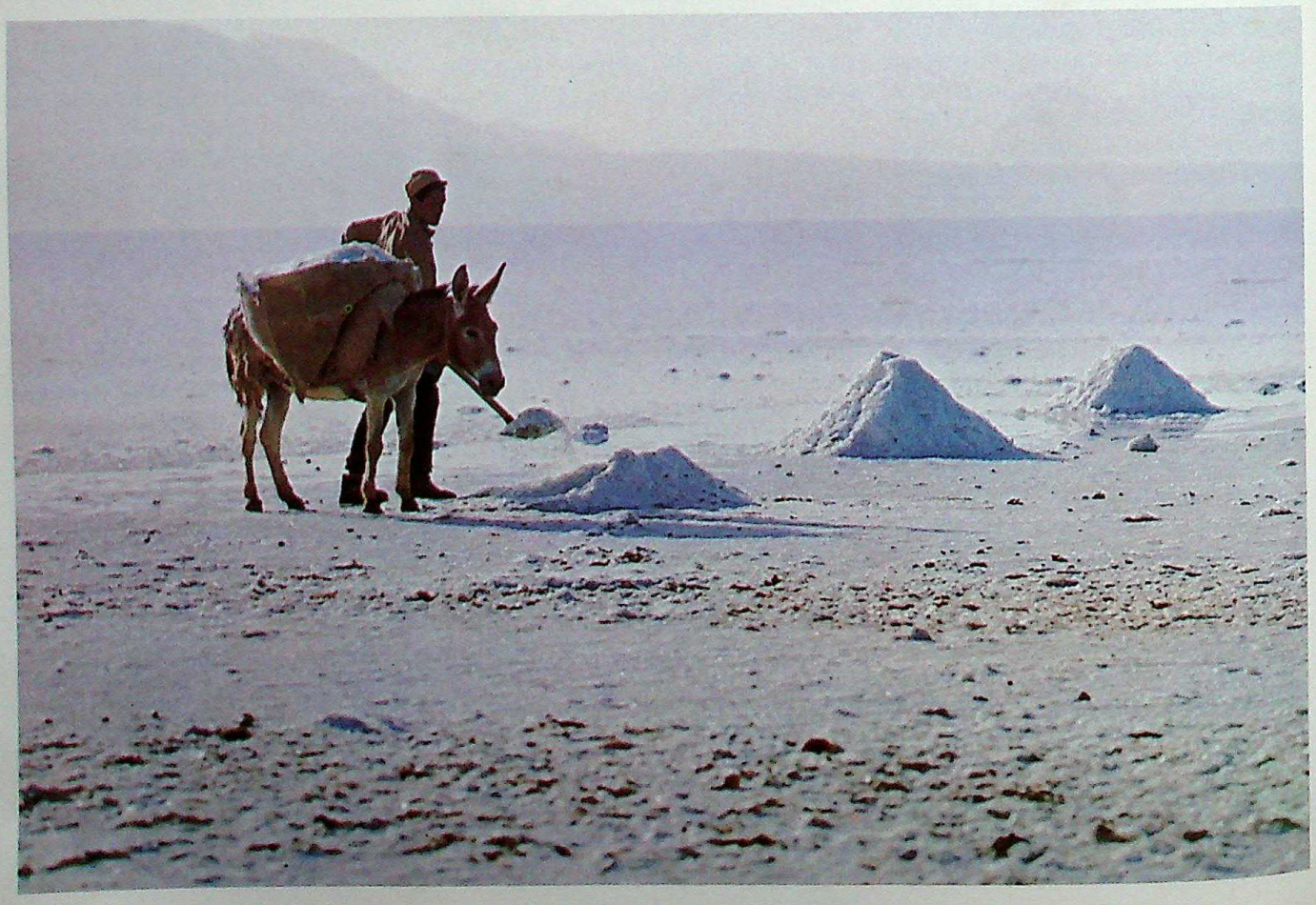
In January the whole of Asia north of Arabia, India and south-east Asia is cool to very cold. In July the entire continent, except for the northernmost USSR and the Tibetan Plateau, is warm to very hot. Average yearly rainfall is heavy in a crescent-shaped belt extending from Japan and Korea, through south-east Asia to India.

In most other parts of Asia, however, rainfall is light. In the vast dry deserts which stretch from Mongolia south-westwards almost to the Mediterranean, scarcely any rain falls each year. Parts of the continent, such as Iran, have a continental climate – burning hot by day and chilling at night.



Above: The Mekong Delta, in South Vietnam, flooded after the monsoon rains of summer.

Below: The Kavir Desert in central Iran is a vast salt wasteland.



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NORTHERN ASIA

The Land and Climate

Northern Asia is bounded on the west by the Urals and in the south by the Hindu Kush, Tien Shan, Altaj, Sayan and Jablonovyj mountain ranges. The peaks of the Hindu Kush rise to above 7,600 metres (25,000 feet), and those of the Tien Shan are almost as high.

Three great river systems flow northwards from the southern mountains and empty into the Arctic Ocean. They include the Ob-Irtyš, the Jenisej and the Lena rivers (the Irtyš is a tributary of the Ob). The Ob, Jenisej and Lena all exceed 4,000 km (2,500 miles) in length and are among the world's twenty longest rivers.

The world's largest inland lake, the salty Caspian Sea, lies on the western border of Asia south of the Urals. With an area of about 371,000 square kilometres (143,000 square miles), it covers nearly twice the area of the North American Great Lakes. East from the Caspian lies the large salt-water lake known as the Aral Sea. Farther east still is the fresh-water Lake Balchaš. The deepest lake in the world, Lake Bajkal, lies to the north-east, north of Mongolia. It is more than 1,600 metres (5,250 feet) deep in places.

The entire northern coastline of Asia is frozen in winter. So is that bordering the Bering Sea and the Sea of Okhotsk in the east. Inland to about the Arctic Circle is a narrow, marshy belt of land called the *tundra*. Here moss grows, but no trees, for the climate is too severe. South of the tundra lies the so-called *taiga*. This is a vast forest of mainly pine and fir trees, which forms part of the great coniferous forest belt that extends across Eurasia.

South of the taiga lies the *steppe*, the vast treeless plain of natural grassland. The steppe is the 'breadbasket' of Russia, where enormous quantities of wheat and other crops are grown. Snowbound in winter, the steppe is very hot in summer, and grain ripens quickly. It has a typically extreme continental climate.

Lake Bajkal is a vast freshwater lake in eastern Siberia which covers an area of more than 30,000 km.

The People of Siberia

The 62 million people of the northern regions of Asia are all citizens of Russia. More than two-fifths of them live in Siberia, which occupies most of the region. Siberia is vast, covering over 15 million square kilometres (nearly 6 million square miles). On average there are less than 3 people to the square kilometre (8 to the square mile) in Siberia. In the rest of Russian Asia there are three times as many people to the square kilometre.

Siberia was virtually uninhabited 400 years ago. Then the Cossacks opened it up in search of furs. The Cossacks were nomadic and adventurous horsemen from south-west Russia. They fought and intermarried with Tartars and other Mongoloid people to form the present population. Later, Siberia was used as a huge prison camp, as was Australia in its early days.

Perhaps the most important development in Siberia was the completion of the great Trans-Siberian Railway in 1905. This 9,340 km (5,800 mile) railway connects European Russia with the Pacific coast. It runs from Moscow in the west to Nachodka on the east Siberian coast. It is the longest railway in the world. As in the United States, colonists followed the railway, and large-scale agricultural development on the American scale began. Coal mining began and engineering plants were set up to provide fuel and repair depots for the railway. Prisoners supplied much of the labour. Fearing that the USSR would be attacked from the west, Russia's communist leaders built a 'second Russia' east of the Urals by 1940. In the mid-1950s, the Russian government began a great campaign to increase agricultural production in the south-west of Siberia, where the best agricultural land is.

The inhabitants of Siberia were

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Colourfully garbed Uzbek nomads ride in a camel caravan.

herdsmen, hunters and trappers until quite recently. Now more than half of the population live in towns. Novosibirsk, the largest city in Siberia, was founded only in 1896. It now has more than 1,250,000 inhabitants. Of these many work in factories making such products as mining equipment, machinery, steel and leather goods. Magnitogorsk is a large steelmaking city built close to the Urals north of Kazakhstan.

Many hydroelectric power plants have been completed in Siberia to supply electricity to the factories, farms and cities. The plant at Krasnojarsk on the River Jenisej is the most powerful in the world. It has an output of more than 6,000 megawatts.

Siberia has become one of the richest mining areas of the world. Its coalfields are vast, being centred in the Kuznetsk Basin (Kuzbass). The Urals are rich in iron ore and many other minerals. Gold is found along the rivers in eastern Siberia and elsewhere, making Russia the second largest gold producer, after South Africa. Petroleum, diamonds and uranium are also mined.

Few people live in the tundra or northern taiga area of Siberia, and in the settled areas life is still harsh due to the climate. In fact all Russian Asia is a pioneering region. However, the farming, mining and industrial communities are being increasingly aided by modern machinery and advanced technology. Central heating, efficient communication by air and rail, shops, schools, cinemas and television have made life much more comfortable.

The Peoples of the South-West

In the south-west of the northern region are five of the union republics which make up the USSR. The large republic of Kazakhstan has just over a fifth of the people of the northern region. It covers much of the fertile steppe grasslands. The once-nomadic Kazakh herdsmen are now outnumbered by Russian and Ukrainian migrants. But few people now rear animals. Many are farmers who cultivate the fertile 'black earth' areas of the steppe. Others work in factories or as miners.

South-west of Kazakhstan lies the small republic of Uzbekistan, which contains another fifth of Russia's Asian population. Its capital city, Taškent, has a population of over 1,390,000. It is one of the largest cities in Russian Asia. Most people in the republic are Uzbeks, who are named after Uzbek, a follower of the Mongol conqueror Genghis Khan. Uzbek cities such as Taškent, Samarkand and Buchara are famed for their Mongol–Muslim architecture. Two-thirds of the people live outside the towns in oases located in the large waterless desert. Many Uzbeks grow cotton.

The remainder of the USSR's Asian people live in the Turkmen, Tadzhik and Kirgiz SSRs. The people are similar to Kazakhs and Uzbeks in their origins and way of life.

Sandwiched between Kazakhstan, Uzbekistan and the Iran and Afghanistan borders is the republic of Turkmenistan. Most of the region is a desert known as the Kara Kum. The two remaining union republics, Tadzhikistan and Kirgizia lie in the rugged foothills of the Pamir and Tien Shan ranges. The Turkmen, Tadzhik and Kirgiz peoples make up only about one-seventh of Asian Russia's population. Farming is the chief occupation.

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CENTRAL ASIA

Central Asia is one of the bleakest and least populated areas of the world. It is a region of barren deserts, high plateaux and towering mountain ranges. For man, animals and plants alike, it is one of the most difficult areas for life to flourish. It is made up of Mongolia, Tibet and Sinkiang-Uighur (Xinjiang), which is China's north-west territory. Tibet is now under Chinese domination.

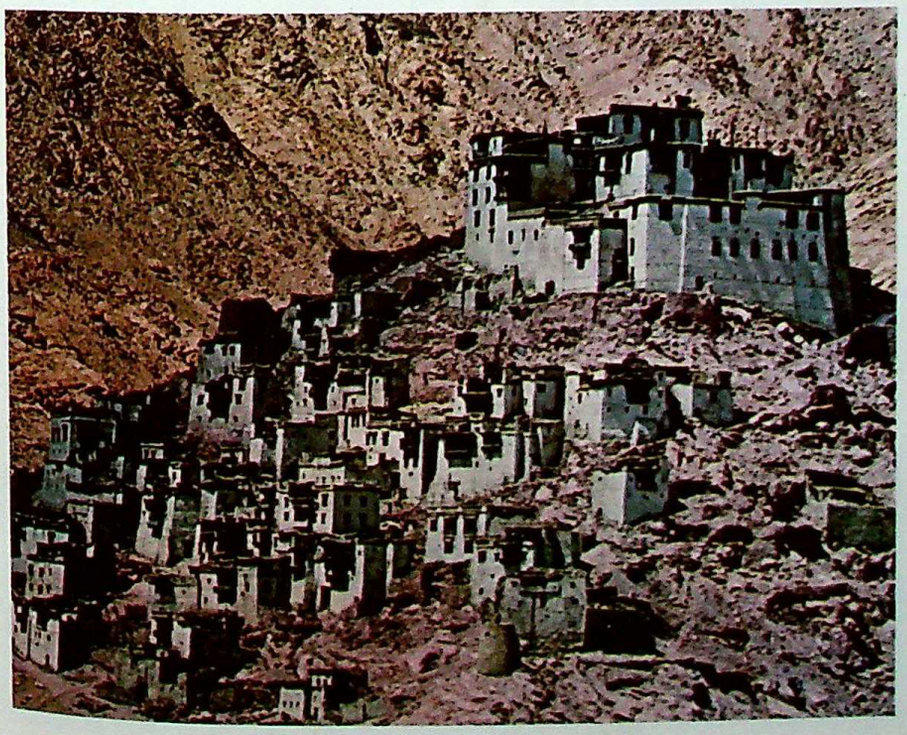
Mongolia and Tibet, which are each nearly half the size of India, both have only about $1\frac{1}{2}$ million people. They have only about one person to each square kilometre, compared with Siberia's three. Sinkiang-Uighur, which is slightly bigger than Mongolia, has about nine million people.

The climate of the region is a severe and extreme one. The winters are bitterly cold, falling to −40°C (−40°F). Yet in the summer the temperatures may exceed 36°C (97°F). But the summers are brief. Rainfall is light throughout the region, and the southern part of Mongolia is a desert, where less than 125 mm (5 inches) of rain may fall every year. The region can also be very windy.

In southern Mongolia is the Gobi Desert, a wasteland with a scant population of nomads.

The Land

In the north of the region is the rugged Mongolian Plateau, where the Mongolian capital, Ulan Bator (Ulaanbaatar), is located. To the north are the Jablonovyj mountains; to the east the Greater Khingan range.



Part of ancient Ulan Bator, capital of Mongolia, which is situated on the rugged Mongolian Plateau.

Going south the plateau gives way to the barren Gobi Desert, which occupies an area of some 1,300,000 square kilometres (500,000 square miles). It lies on average between about 600 and 900 metres (2,000–3,000 feet) above sea level. West of the desert are the Altaj Mountains, source of the great Ob and Irtyš rivers.

In the west of the region lies the Takla Makan desert, which is almost enclosed by the Tien Shan and Pamir mountain ranges and the great Tibetan Plateau.

The Tibetan Plateau covers about one-third of the region, and on average is more than 4,800 metres (16,000 feet) above sea level. It is bordered on the north and north-west by the Kunlun mountain range and to the south by the Himalaya. This range, 2,400 km (1,500 miles) in length, averages 6,000 metres (18,000 feet) in height in its central portion. It rises to 8,848 metres (29,028 feet) at Mount Everest, the world's highest mountain. Few people live in these areas. The climate, remoteness and lack of suitable vegetation have made human habitation difficult.

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Tibet, together with the neighbouring Chinese province of Tsinghai (Qinghai), is the source of most of the great rivers of southern and south-eastern Asia. These include the Indus, Brahmaputra, Salween, Mekong, Yangtze and Huang. Much of Asia's most fertile land lies in the valleys of these rivers.

The Himalaya mountain range runs for more than 2,500 km, and has 30 peaks over 7,000 m high.

Mongolia

Mongolia was the country from which in the 1200s, the biggest land empire in history was formed. The nomadic, tent-dwelling Mongolians rode their small horses into central Europe, recruiting conquered people to their armies as they advanced. Mongol power declined in the 1300s.

Until about 1955, most Mongolians continued their nomadic life. They lived in portable felt tents on wooden frames called *ger* or *yurts*. They wandered across the barren countryside seeking pastures for their great flocks of sheep and goats. They also herded large numbers of cattle, horses and two-humped (Bactrian) camels.

Then in about 1955, the Mongolian government began to reorganize stock-rearing. It grouped the nomads into large, ranch-like settlements which had all the facilities of towns, with schools, shops, clubs and medical centres. Crop agriculture, previously unknown in Mongolia, was begun on large mechanized modern farms, directed by the government. Crop farming is possible because vegetation grows quickly though briefly in the sharp summer rains. In addition some Mongolians became miners or drifted into industry. Since 1955 life in Mongolia has changed more than in the previous 500 years of its history. Buddhism, the main religion, is fast disappearing.

One Mongolian in five lives in the capital Ulan Bator (Ulaanbaatar), which has now developed some industries. It is connected by rail to the Trans-Siberian Railway in Russia and to the Chinese capital Peking (Beijing). Coal and other minerals are mined in some regions and oil is produced at Sajnšand.

Tibet

Tibet has always been one of the world's least-known places. It is completely cut off from the rest of the world by its geographical position. The mysterious land was for centuries controlled by feudal nobles and monks of the Lamaist (Tibetan Buddhist) religion. Most of the people lived in the south of the country, where the capital Lhasa (Lasa) is located. Many were farmers; some were nomads. Some traded simple products with the Nepalese, Indians and Chinese across the borders.

Religion was very important to the Tibetans, who accepted the leadership of the chief monk, called the Dalai Lama. The Dalai Lama was believed to be part human, part divine. When a Dalai Lama died, the monks sought his spirit and claimed to find it in the boy who became the new Dalai Lama. For hundreds of years, the Chinese have claimed right to Tibet and finally, in the 1950s, they occupied it. The old way of life of the people was destroyed. Since that time many Chinese have settled in Tibet, and now outnumber the native Tibetans.

Sinkiang-Uighur (Xinjiang-Weiwuer)

China's north-west territory of Sinkiang-Uighur contains the desert of Takla Makan. It is bounded on all sides except the east by high mountains. Most of the population are farmers who have settled in irrigated oases. Others are nomadic herdsmen. Oil and other minerals are beginning to be exploited, and manufacturing industries have been started in some towns. The largest city and capital of the region is Urumchi (Wulumuqi) whose population is about 400,000.

Most of the population are Uighurs, who are a Mongol people similar to the Turks. Kirgiz and Kazakh peoples also live there. They are the same people who inhabit the neighbouring union republics across the border in Russia. The traditional religion of Islam is declining.

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EASTERN ASIA

The Land

Eastwards from Tibet the land descends in 'steps' through the Loess Highlands to the great plain of China. Flowing eastwards from Tibet are the two great rivers of China – the Huang (Yellow) and the Yangtze. Where they pass the edges of the 'steps' they cut deep gorges. The 4,350-km (2,700-mile) Huang empties into the Bohai, an arm of the Yellow Sea north of the Shandong Peninsula. The Yangtze empties into the East China Sea near Shanghai. With a length of some 4,990 km (3,100 miles), it is one of the world's longest rivers. A wide belt of the Plain, extending about 500 km (300 miles) north and south of the Huang, was once a shallow sea. Now, this highly fertile area is covered with silt and *loess*, a fine yellow dust. For thousands of years – long before known history – windblown loess from the Gobi Desert has been deposited on the great plain. Near to the Gobi it is 60 metres (200 feet) or more deep. Peking (Beijing), China's capital, suffers from loess dust storms and even ships at sea are coated with the yellow loess. This explains why the Chinese use the names Yellow River and Yellow Sea. Although the loess is from the dry desert, it becomes highly fertile soil when flooded by the water of the Huang and its tributaries. Although the Huang has always been vital to farming in northern China, the Chinese nicknamed the river 'China's Sorrow' because of the floods it brought.

South of the Loess Highlands is Qinlingshan – a mountain range with peaks averaging 4,000 metres (13,000 feet). Farther south still is the Yangtze. In the valley of the Yangtze live some 300 million people, which is equal to three-quarters of the population of Africa. The Xi (West) is the only large river in southern China. It flows into the South China Sea near Canton (Guangzhou) and Hong Kong.

Korea is a mainly mountainous country. But there are wide coastal plains in the west, where the capital of North Korea (Pyongyang) and South Korea (Seoul, or Sŏul) lie. Several rivers rise in the eastern mountains and flow into the Yellow Sea. The Yalu River flows south-west from China to form part of its border with Korea.

A Shinto shrine at Miyajima, in Japan. Shinto is the original native religion of Japan, and is still widely followed.

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In many parts of China a constant battle is waged against erosion. Farmers often terrace hillsides to prevent the soil washing away.

North to south, Japan's four main islands are Hokkaido, Honshu (the largest), Shikoku and Kyushu. The whole of Japan is really a mountain range rising from the sea. The only reasonably large flat area is the Kanto Plain in the east of Honshu. It contains the Japanese capital Tokyo, and Yokohama. The highest mountain on Honshu is Fuji (3,776 metres, 12,388 feet), considered sacred by the Japanese. It is an inactive volcano. Thousands of short, fast-flowing streams flow down the mountains. The longest river, the Shinano in Honshu, extends only about 260 km (160 miles). The largest lake, Biwa on Honshu, covers about 674 square kilometres (260 square miles).

Japan is much at the mercy of natural forces. It has about 200 volcanoes and is subject to earthquakes. In 1923 an earthquake and the fire it caused killed 140,000 people in Tokyo. The Japanese islands form part of the great 'ring of fire' which girdles the Pacific Ocean (see page 55).

The Climate

The July temperatures over most of eastern Asia are fairly similar. They vary from about 24°C (75°F) at Shenyang (formerly Mukden) in north-east China, to 26°C (79°F) in Tokyo, Japan and 28°C (82°F) in Hong Kong off southern China. The climate is very much influenced by the warm, moist summer monsoon winds blowing inland from the sea.

January temperatures at the three places mentioned vary considerably, however. Shenyang, inland in the north-east, is affected by the icy winter monsoon blowing from Central Asia. Its average temperature in January is about −13°C (9°F). Tokyo, near the eastern coast of Honshu, is uncommonly warm for its latitude. Its January temperature averages 3°C (37°F). It is warm in winter because of the warm Japan current flowing northwards past the eastern coast. The western coasts of Japan are cooler in winter, however. They are swept by the cold winter monsoon, and are also affected by the cold waters of the Oyashio current flowing southwards from the north. Hong Kong, much further south, lies in the tropics, and the January temperatures average more than 16°C (60°F).

Rainfall in northern China is only about 250 mm (10 in). Southwards it increases to about 1,000–1,500 mm (40–60 in), which is almost twice that of Europe. Most rain comes with the summer monsoon. Except in the north, Japan's precipitation tops 1,500 mm (60 in). The destructive tropical storms called typhoons often sweep the southern coasts of China and Japan from June to November. In 1922 a typhoon struck Swatow (Shantou), northeast of Hong Kong. A vast wave swamped the city, and 50,000 people were killed.

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China

China has made great industrial progress since its civil war ended in 1949. But most of its 800 million people are still farmers. In particular they cultivate the fertile plains in north-central China, the coastal areas and the river valleys.

Although about three-quarters of the Chinese live in rural areas, China has some of the biggest cities in the world. They include Shanghai (population about 11 million), the capital Peking (Beijing, $7\frac{1}{2}$ million), Chungking (Chongqing, 5 million), Dairen (Lüda, $4\frac{1}{2}$ million), Tientsin (Tianjin, 4 million), Nanking (Nanjing, $3\frac{1}{2}$ million), Anshan and Shenyang (Mukden, 3 million each). Canton (Guangzhou) and Harbin (Haerbin) also have populations between 2 and 3 million.

On the great plains of the Huang and the Yangtze the farmers crowd together with several hundred living in each square kilometre. In the fertile river mouths there may be more than 1,000 to the square kilometre (2,500 to the square mile). Millions live entirely on the rivers in houseboats.

Before 1949 the Chinese lived together in large family groups of up to 200 members. Family life and religion were important, and each family had its collection of gods. The poor people lived in bamboo huts covered in clay, with rickety bamboo furniture. Pottery and china vessels were much prized and inherited from one generation to another. Food and goods were often carried on the shoulders using 'one stick and two baskets'. This method is still used throughout eastern and south-east Asia. Practically all the people worked on the land and paid high rents and taxes to landlords and warlords who claimed to protect them.

After 1949 the communist government handed over the land to the farmers who worked on it. Later their farms were grouped together in large units called *co-operatives*. Both town and country-dwellers were encouraged to live in large communist groups called *communes*. Food, clothing, shelter, medical attention and education were provided for everyone. Under these conditions people lost the right to live as they chose and family ties became weaker. Religion also greatly declined under communist influence.

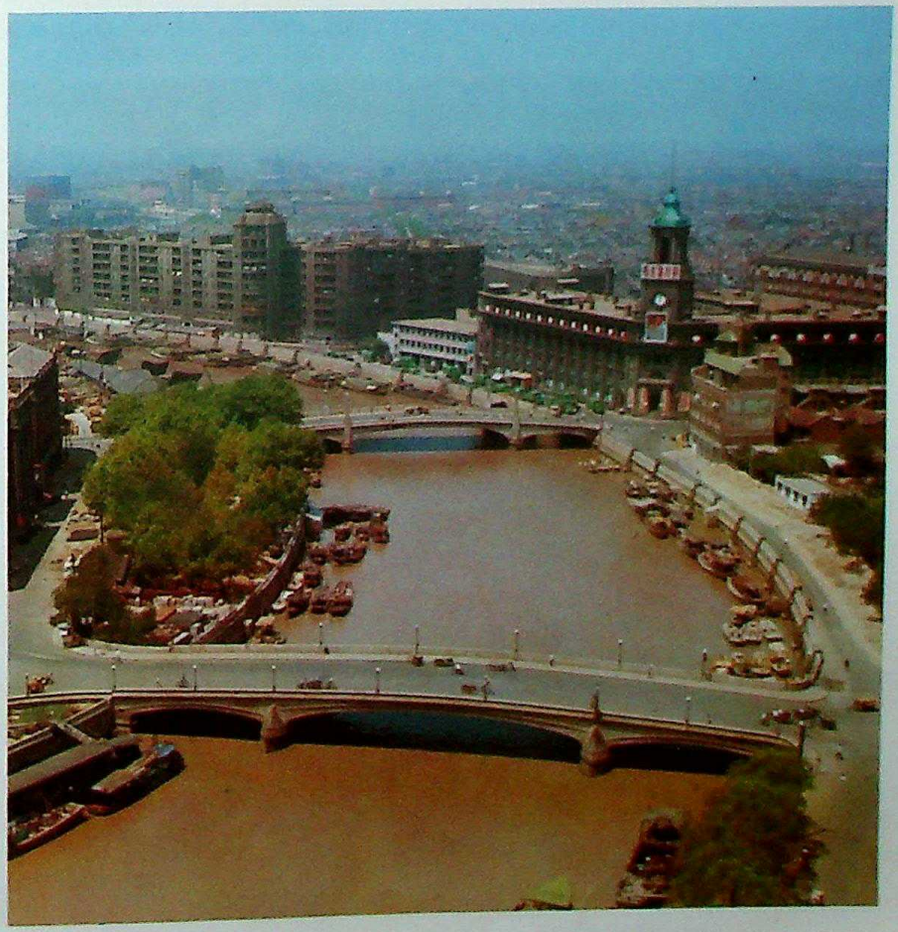
The Chinese are noted for the rich variety of their cooking which has become familiar to people in other countries. We might consider it one of their best-known exports. But in China itself most of the rapidly expanding population eat plain fare. Meat has become a luxury.

Several million Chinese live outside China, where they form industrious and prosperous communities. Many large cities have their own Chinese quarter, or 'China-town', where the Chinese carry on many of their customs.

Agriculture and Industry

China is the world's greatest farming community in terms of overall production. But its farming methods are still in general primitive. Machinery is used far less than it is in Europe. For example, only about an eighth of the land can be cropped. A third is suitable for livestock. The remainder is too rugged or too dry for pastures or crops to flourish. The Chinese have so little fertile land that in places they cultivate the hillsides as well. They have made terraces, which help prevent the rain washing the soil away. In dry regions they irrigate (water) the land.

The chief crops grown in China are rice, wheat, maize and cotton. Rice thrives in the flooded paddies of southern China. Most wheat is grown in the Loess Highlands on the North China Plain on either side of the Huang, and on the Manchurian Plain in the north-east. The maize-growing region extends in a broad belt from the south-west to the north-east of the country. The Yangtze valley produces most of China's cotton. Cotton is also grown on the North China Plain and in the Loess Highlands. The Chinese



Shanghai is one of China's biggest seaports, on the Huang p'u river close to the Yangtze estuary.

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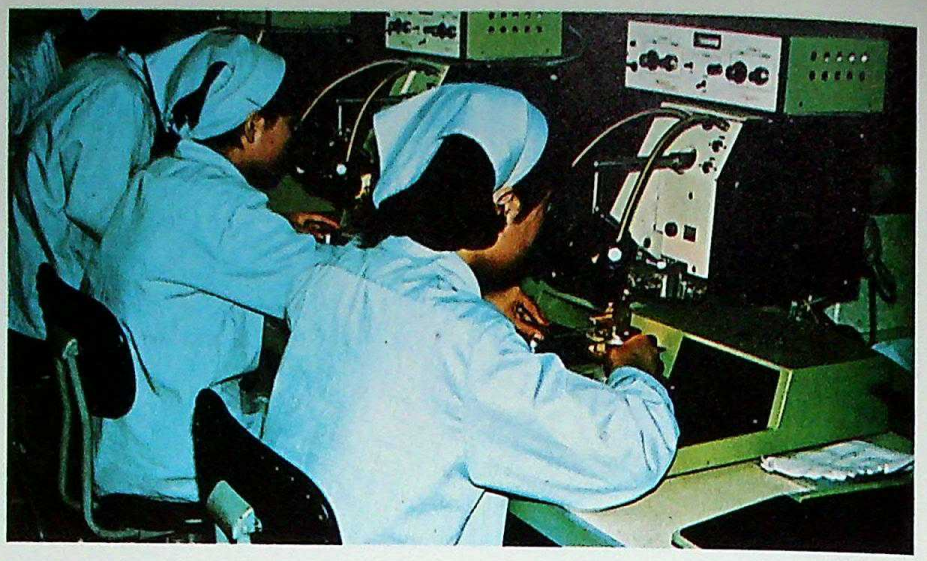
are also great livestock farmers. They keep more pigs than any other country, and pork is their chief meat. Sheep and goats are also raised on the plains and in the highlands where grazing is poor. Animals such as oxen and water buffalo are reared to pull carts and farm implements. When the communists came to power in 1949, there was scarcely any industry to speak of in China. With Russian help China began to develop its mining and manufacturing industries under a series of five-year plans. Today it is exploiting its vast mineral wealth and has well-developed heavy industries. The main region for mining coal and iron ore is the north east. And it is in this region that heavy industry has developed most. Anshan, Harbin (Haerbin) and Tientsin (Tianjin) are major industrial centres. In southern China many other minerals are mined, including tin, antimony, tungsten, copper, gold, lead and zinc. The textile industry is the most important of China's light industries. The industry is centred in the east of the country around Nanking (Nanjing), Shanghai and Hangchow (Hangzhou). These cities process the cotton grown in the Yangtze valley and make other textiles.



Making electronics equipment in Taiwan. The Taiwanese excel at this delicate kind of work.

Hong Kong, Macao and Taiwan

Macao (Macau) is a tiny port belonging to Portugal on the southern coast of China, near Canton (Guangzhou). It became a Portuguese trading settlement 400 years ago. By 1842 it had been overtaken in importance by Hong Kong, a nearby island which had been seized by British traders. By 1898 the territory of Hong Kong had expanded onto the mainland. By treaty, most of the mainland (the *New Territories*) is to be returned to China in 1997. Hong Kong is a British Crown Colony consisting of Hong Kong island, a portion of the Chinese mainland and several other islands. It has an area of 1,030 square kilometres (398 square miles) and a population of about 4 million people. 'Hong Kong' means 'fragrant harbour', and it indeed has one of the most beautiful natural harbours in the world. Its people fish and work in industry for a living. Many live on boats, while others live in makeshift accommodation. The city of Victoria on Hong Kong island is the capital. It is a bustling business centre. Much of Hong Kong's prosperity has arisen because it provides an outlet for exports from China.

Taiwan (Formosa) is an independent Chinese island off south-east China. It became the base for those defeated armies who retreated from the Chinese mainland after defeat by the communists in 1949. Many of the people are farmers and fishermen. An increasing number are going to work in the island's expanding industries. The capital of this mountainous island is T'aipei.

A high-rise apartment block in Hong Kong, used to rehouse people from the shanty towns on the outskirts.

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Japan

Japan was virtually isolated from the rest of the world until 1868 when the emperor led a movement to industrialize and 'westernize' the country. By then it was probably 200 years behind Europe in development. Japan's progress amazed the world. Within 100 years it had become the world's third nation in terms of total production after the United States and Russia. This is remarkable when you consider that only one-seventh of Japan's land can be cultivated and the country has few natural resources. By the mid-70s the average income of each Japanese was higher than that of people in most European countries. Japan's wealth comes from its ability to supply the world cheaply with good-quality goods. Between 1963 and 1974 Japan trebled its industrial production. It now leads the world in shipbuilding; is second after the United States in vehicle production and third in the production of steel. It is a leading producer of optical equipment, machinery, electronics, textiles and fertilizers.

One of the main industrial regions in Japan contains the towns Osaka, Kobe and Kyoto. The main industries are textiles and shipbuilding. Kitakyushu is the centre of Japan's heavy industry, and steelworks, chemical plants and other industries are found there. Tokyo, Yokohama and Nagoya are other major industrial centres. Three-quarters of Japan's people now live in cities and towns. Tokyo, the capital, contains $11\frac{1}{2}$ million people and is one of the biggest cities in the world. The world's fastest trains run between Tokyo and Osaka on the new Tokaido line. The line is being extended and will eventually link most of Japan's main areas. Tunnels have been driven between the main islands.

Most Japanese workers are employed either in industry or in offices. Only about one sixth are farmers. Rice is still the basic food and is planted on half the cropland and most is grown in paddies or flooded land, on terraces on the hillsides. Mulberry trees are cultivated for their leaves which are fed to silkworms. The Japanese produce more silk than any other country. Apples, pears, oranges and tangerines are among the fruit grown. Fish is also extremely important in the diet of the Japanese and fishing is a major industry. The Japanese also have a large whaling fleet.

Despite 'westernization', many of the Japanese still value their traditional ways of life. Family life and religion remain strong. Most Japanese homes are single-storey. They usually contain little furniture and the people sit on cushions around a low table. They usually eat with chopsticks. They often wear loose clothes at home, though usually western-style clothes at work. The traditional Japanese clothing, the kimono, is usually worn only on special occasions. Almost all the inhabitants of Japan are Japanese, and belong to the Mongoloid racial group. But about 16,000 Ainu people live in the north. They are survivors of Japan's ancient Caucasoid white population. They have their own language and culture, though these are gradually disappearing. The men are noted for their bushy hair and beards.

Tokyo has the severe rush-hour traffic jams that plague most of the world's capital cities.

Korea

Korea lies between China and Japan, both of which have dominated its history. In physical appearance Koreans are similar to the Chinese and Japanese. After the Japanese occupation of Korea ended in 1945, the country was divided into two nations – North Korea and South Korea. They fought a bitter civil war in the 1950s, which threatened to develop into a third world war. The Communist Chinese fought with the North, while United Nations (mainly American) forces aided the South.

Two-thirds of Korea's 50 million people live in the South. In the past most Koreans followed Chinese religions, although some were Christians. However, religion is now declining.

In the North more than half the people are employed in industry. North Korea has valuable mineral resources, including coal, gold and iron ore. Its industries produce steel as well as chemicals, textiles and other products. South Korea has few important mineral deposits except for tungsten ore. It has some heavy industry but the textile industry is more important.

In South Korea, most people are farmers. They grow mainly rice, as well as maize, millet and vegetables. They also grow tobacco and cotton, and cultivate silkworms for the silk industry.

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SOUTH-EAST ASIA

The Land

None of the mountain ranges in South-East Asia compare in height with those of central Asia. The highest peak in the region is Hkakabo Razi in northern Burma (5,881 metres, 19,295 feet). Generally, the land reduces steadily in height southwards from the Tibetan Plateau. A more or less continuous range of mountains stretches north–south along the eastern Burmese border down to the narrow Malay peninsula.

Almost all Burma, except the valley and delta of the Irrawaddy River, is between 200 and 2,000 metres (650 and 6,500 feet) above sea level. So is most of Laos and Vietnam. Laos is a country of rugged mountains and plateaux. Northern North Vietnam is very mountainous and has Vietnam's highest peak, Fan Si Pan (3,142 metres, 10,308 feet). The land slopes down towards the coast to the large Red River Delta. Most of the crescent shaped South Vietnam is mountainous except in the extreme south in the low-lying Mekong Delta.

Most of Thailand, Cambodia and Singapore are less than 200 metres (650 feet) above sea level. The coastal plains of Malaya are also low-lying, but the land rises in the interior to more than 2,100 metres (7,000 feet).

The chief rivers of mainland South-East Asia include the Irrawaddy and Salween, which flow north to south through Burma.

Paddy fields in the north of Sumatera, one of the four main islands that make up Indonesia. Most of the island is covered in mountains, swamps and jungle.

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The Irrawaddy is more than 2,000 km (1,250 miles) long, and the Salween, 2,800 km (1,750 miles) long. The 4,200 km (2,600 mile) Mekong River forms part of the Thailand–Laos border, then it crosses Cambodia and South Vietnam to enter the South China Sea south of Saigon. The Black and Red rivers, which rise in Yunnan, China, flow across North Vietnam into the Gulf of Tonkin. The largest lake in the region is the highly important Tonle Sab in Cambodia, which teems with fish. It covers an area between 2,500 and 25,000 square kilometres (1,000 and 10,000 square miles) according to season.

The Philippines consists of about 7,000 rugged and jungle-covered islands, of which over 6,000 are uninhabited. Luzon in the north and Mindanao in the south are the largest, with areas of 104, 700 and 94,600 square kilometres respectively (40, 400 and 36,500 square miles). Nearly all the Philippines lies between 200 and 2,000 metres (650 and 6,500 feet) above sea level. The highest peak is Mt Apo in Mindanao (2,954 metres, 9,692 feet). It is one of several active volcanoes in the Philippines.

They form part of the so-called 'ring of fire' girdling the Pacific Ocean. This fiery ring of volcanoes marks the edge of the Pacific plate of the Earth's crust. (See page 55.)

Being composed of islands, the Philippines has few long rivers, but several short, fast-flowing ones. Only rafts and small boats can navigate them. One important navigable river is the Cagayan, which flows through fertile valleys in north-east Luzon. The crescent-shaped Laguna de Bay on Luzon is the largest lake.

Stretching for more than 5,000 km (3,000 miles) between the peninsula of Malaya and the Philippines are a string of more than 3,000 islands. Over half of them are uninhabited. The largest are Borneo, Sumatera, Sulawesi (Celebes) and Jawa (Java). The western part of New Guinea (West Irian) is regarded as part of Asia, while the eastern part (Papua/New Guinea) is considered part of Oceania. The whole island of New Guinea is the world's second largest island, after Greenland. Its area is about 820,700 square kilometres (316,800 square miles). Borneo is the third largest island in the world, with an area of 746,400 square kilometres (288,200 square miles).

These Filipino fishermen fish with their faces covered. They think that if the fish see their faces, they will be frightened away.

The four islands just mentioned form what are called the Greater Sunda Islands. East of Jawa are the smaller Lesser Sunda Islands, which extend from Bali to Timor. Between Sulawesi and New Guinea are numerous small islands, which form Maluku – the Moluccas, or Spice Islands.

Mountain chains extend north-west to south-east along Sumatera's western coast, and eastwards through Jawa to Timor. They consist of a string of volcanoes. Many are active, while many more are dormant (sleeping), but still likely to erupt again one day. This ring of islands also lies in a region where two plates of the Earth's crust are coming together. On Borneo a high mountain range stretches from south-west to north-east. Its highest peak, Mt Kinabalu (4,104 metres, 13,464 feet) lies in the extreme north-east. New Guinea has a backbone of high mountains, stretching roughly north-west to south-east. The highest point, which lies in the western part, is Jaja Peak (5,031 metres, 16,506 feet).

Dense jungles cover most of the islands in South-East Asia, except where they have been cleared for farming. In the lowland areas along the coasts large swamps often occur. In places, however, as in Jawa, the coastal plains are fertile and intensively cultivated.

The Climate

Most of South-East Asia has a monsoon climate, with a mainly dry and mainly wet season. From May to October south-west winds blow from the southern Indian Ocean across most of South-East Asia. They are laden with moisture and bring heavy rain. Indonesia, mostly south of the Equator, is swept by the south-east trade winds. From November to April, the wind directions are roughly reversed. Most of the region thus receives heavy rain from May to October – up to three times as much as Europe. Especially wet are the western coasts of Burma, Thailand, Sumatera and the Philippines. From November to April most of main-

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land South-East Asia is comparatively dry. The Philippines and the Indonesia Islands have rain throughout most of the year, however.

Despite the fairly regular monsoons, the rainfall pattern is varied and complex throughout the region. For example, Singapore, which lies a few degrees north of the Equator, has an average annual rainfall of more than 2,300 millimetres (90 inches). But it falls mainly in sudden showers.

Temperatures in the region average about 26°C (79°F). They are higher in daytime, and lower at night. Northwards from the Equator the variation in temperature tends to be greater. While Singapore has a variation of only 2°C (3.6°F), the temperature in Mandalay, Burma, varies 11°C (19.8°F).

Life of the People

Between 60 and 80 out of every 100 working people in South-East Asia are farmers. Most of them grow rice, which is the main food. Most of the population therefore live in the country. On average South-East Asia has almost 80 people to the square kilometre (200 to the square mile). This is only a third of the population density of Britain. However, some regions are very densely populated. The Indonesian island of Jawa has 700 people to the square kilometre (1,800 to the square mile).

The biggest city in the region is Jakarta (5 million), the capital of Indonesia, on the island of Jawa. In Thailand, Bangkok (Krung Thep) has a population of 4¼ million, 1 million more than Rangoon, the capital of Burma. The capital of South Vietnam, Saigon, has 3 million. The city of Singapore and Phnom Penh, the capital of Cambodia, have 2 million each.

Rivers and other waterways are especially important in South-East Asia. Much of the land is covered by jungle or rugged mountains, and few roads exist even in the low-lying areas. Many people live by rivers, lakes or the coasts, in houses built on stilts.

In Brunei and elsewhere in South-East Asia people still live in stilt houses above the rivers.

These houses are constructed of forest products such as timber, bamboo and palm leaves. The waterways provide fish for food and 'highways' for boats. A common means of transport in South-East Asia's towns is the trishaw. The passenger sits in an upholstered seat on a tricycle that is pedalled by the driver.

The people of South-East Asia live and work close to nature in hot, humid conditions, and they often wear little clothing. The most common form of dress is the *sarong*. This is a single piece of cloth wound around the waist and worn like a long skirt. It is worn by both men and women. The sarong varies from place to place. The Burmese sarong, or *longyi*, has its vertical sides sewn together to form a roomy skirt that is tucked together at the waist. The sarongs are often brightly coloured and patterned. The cloth is often dyed by the traditional batik method. In many cities, nowadays, however, Western dress is beginning to replace traditional clothing.

The whole of South-East Asia has had a troubled history. Only Thailand escaped becoming a colony of the Western nations. In 1942–1945 the region was a battlefield in which the Japanese fought the Western powers. Later, civil wars were fought in almost every country. Vietnam knew no peace for 35 years (1940–1975). By the 1970s the scale of the war in Vietnam threatened to destroy the nation. In Cambodia the communist victory in 1975 brought many people a changed way of life. Townspeople were sent into the country to become farmers, and peasants replaced them in the towns.

Despite war, however, most of South-East Asia has increased its prosperity. It has been helped by recent changes in world prices. Prices for foodstuffs and raw materials have risen steeply in relation to those for manufactured goods. This means that South-East Asian countries now export their rubber, tin, timber, palm oil, petroleum and other primary products more profitably. They can afford to buy more machinery and other manufactured goods from the industrial nations.

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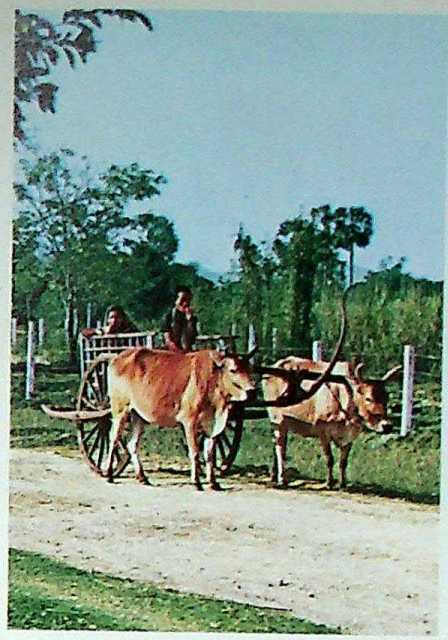
Mainland South-East Asia

This region includes Burma, Thailand, Laos, Cambodia and Vietnam. Except for Laos, minority groups account for less than a quarter of the population in each country. The Burmese are related to Tibetans. The Thai, Lao and Vietnamese are close to the Chinese in appearance. Most Khmers (Cambodians) are darker and look more like Indians. Most people follow the Buddhist religion.

Of the people in the region only one person in six lives in a town. Chinese live in all the cities of the area. They are prominent in business and trade, as they are in most cities in South-East Asia.

Burma is one of the world's leading rice growers. Most rice is grown in the Irrawaddy Delta, which has a hot, humid climate. The river valleys are also intensively cultivated. Other crops are grown besides rice, including beans, cotton, groundnuts, rubber, sugar and tobacco. Irrigation is necessary in the drier areas of the country. Burma is noted for its teak forests, which provide valuable timber for export. As in most of South-East Asia there is little industry in Burma. Mining is quite important, however, in the mountains of the north and east. Lead, tin, antimony and tungsten ores are among the minerals excavated. Precious stones and the best jade come from Burma, too.

Thailand is called by its people Mung Thai, meaning 'Land of the Free'. And it is in fact the only country in South-East Asia never to have been ruled by Europeans. It used to be called Siam. Rice is again the most important crop of the country, whose most fertile region is the central plain north of Bangkok. Some Thai farmers cultivate rubber trees in the south. Coconuts, cotton, maize and other crops are also grown. The forests, which cover more than two-thirds of the country, provide teak and other valuable woods. Teak production is centred in the north of the country around Lampang. Of the several minerals mined in Thailand, tin is the most important.

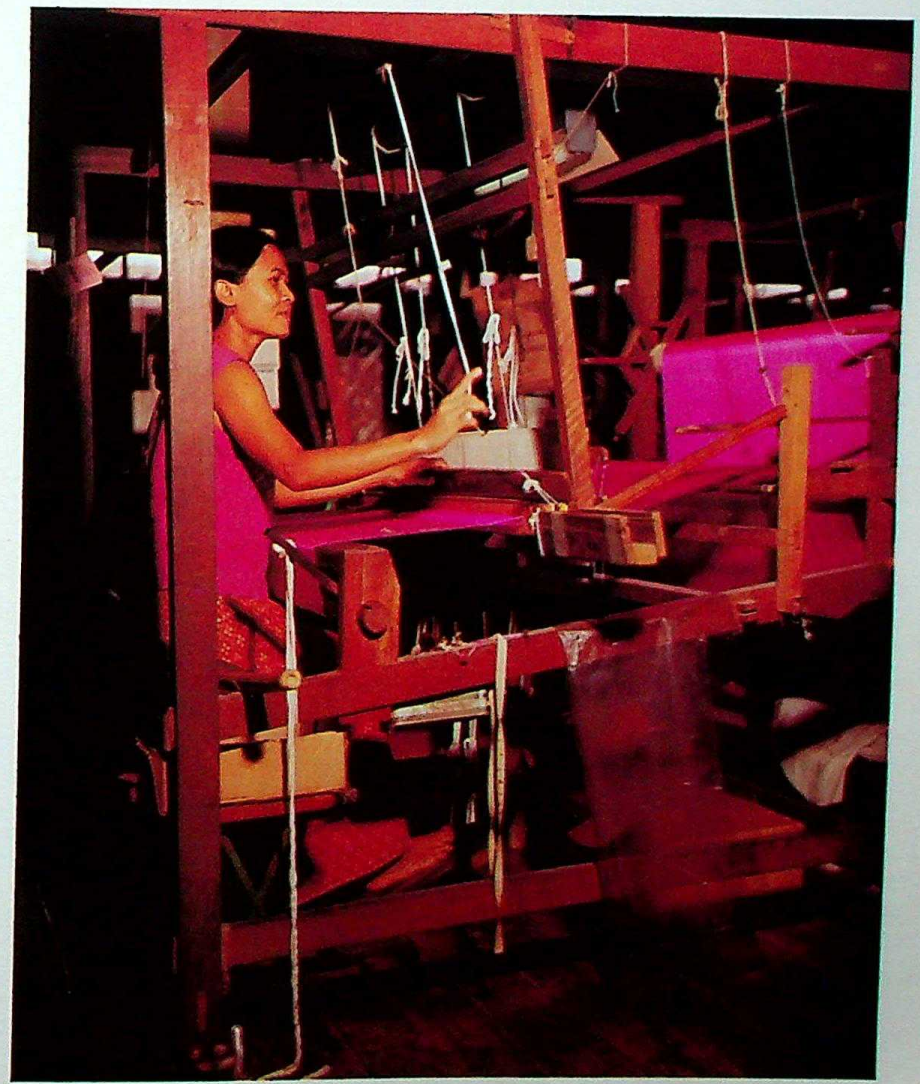


Above: Ox-drawn carts are still a major means of transport in rural South-East Asia.
Below: Thailand is world famous for the brilliantly coloured silks its women weave by hand.

In Laos the people farm the river valleys and the mountain slopes. Maize, coffee, citrus fruits and tobacco are cropped, as well as rice. The forests yield timber, bamboo and products such as quinine (a drug used to treat malaria) and cinammon (a spice). Some cattle are kept and a little tin is mined.

Cambodia grows much the same kind of crops, and raises some livestock. The timber industry is very important. Rubber is produced on quite a large scale. The large lake Tonle Sab supports a large fishing community, which dries fish for export to neighbouring countries.

In Vietnam the most densely populated regions are the delta regions of the Red River in the North and the Mekong in the South. These regions contain the two capitals – Hanoi in the North and Saigon in the South. Most rice is grown in the delta regions.



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Coffee, tea, sugar, maize and copra (dried coconut flesh) are other agricultural products. Coal is mined on quite a large scale in the North, together with some minerals. The few factories there are produce mainly textiles.

Malaysia, Singapore and the Philippines

Malaysia is made up of the southern part of the Malay Peninsula, together with the states of Sarawak and Sabah in northern Borneo. Malaysia's 12 million people are of very mixed origins. Out of every 100, about 46 are Malays, 38 Chinese and 10 are of Indo-Pakistani descent. In appearance, Malays have some similarity to both Chinese and Indians. Various tribal groups exist in Malaysia. For example, the Dayaks live in Sarawak. They used to be head-hunters.

Singapore is a tiny crowded island country at the southern tip of the Malay Peninsula. Three-quarters of its 2¼ million people are Chinese and almost all of them live in Singapore City or in other towns. Most Singaporeans are prosperous, like the citizens of oil-rich Brunei. Brunei is a tiny independent territory in northern Borneo.

The 45 million people of the Philippines are mainly Malay in origin, but have intermarried with Chinese and Europeans. Following 300 years of Spanish occupation, the main religion is Roman Catholic Christianity. But people in the southern islands are mainly Muslim.

Malaysia is one of the more prosperous countries in Asia. Its prosperity depends largely on its main crop – rubber, which is cultivated in huge plantations. The main plantations are on the western side of the Malay peninsula. Malaysia's capital, Kuala Lumpur, is a centre for the rubber trade. The demand for rubber has decreased in recent years as countries use more and more synthetic rubber, and oil palms are now being grown on a large scale, replacing old rubber trees. Rice is the main crop grown for food.

Kuala Lumpur grew up as a tin-mining centre, and tin is still by far the most important mineral produced. Malaysia leads the world in tin production. Most tin is mined in the states of Perak and Selangor.

Tapping rubber on a Malaysian plantation. Malaysia is the world's largest rubber producer.

On the tiny island country of Singapore there is little scope for agriculture. Singapore earns most of its income from trade and services such as banking and shipping. Less than one-thirtieth comes from agriculture and fishing. Singapore has some of the best docks and warehouse facilities in Asia. It is a free port, where goods can be unloaded, stored and reloaded without payment of duty.

Most farms in the Philippines are small, and are located on the coastal plains or in the river valleys. The hillsides are also cultivated where the soil is good. The chief crop is rice, which is grown on all the large islands. The largest island, Luzon, grows most rice. Sugar cane is also grown there, as it is on Negros and Panay too. The Philippines is one of the world's leading sugar producers. Huge coconut plantations are cultivated, mainly to produce copra. Another major product of the islands is Manila hemp, from which tough ropes are made. Manila hemp is the common name for abaca fibre. Abaca is a tall plant related to the banana. Tropical fruits such as mangoes, bananas and pineapples are grown. Most of the few industries that there are on the Philippines process agricultural products. Gold and some other minerals are mined.

Indonesia

Indonesia is made up of the large islands of Sumatera, Jawa and Sulawesi, the southern two-thirds of Borneo, Western New Guinea and about 3,000 other small islands in the vicinity. The Indonesian part of Borneo is called Kalimantan. Indonesian New Guinea is called West Irian. The chain of Indonesian islands extends west to east, over 5,000 km (3,000 miles). This is roughly the distance from Britain to the borders of China.

Racially the Indonesians are closely related to the Malays. In appearance they have some similarity both to the Chinese and to the Indians. Most of them are Muslims. Although Indonesia has rich resources, its people are the poorest in South-East Asia. The main occupation is farming.

Most of the Indonesian islands are sparsely populated, or uninhabited, and two-thirds of all Indonesians live on the fertile island of Jawa. Yet Jawa has over 100 volcanoes, several of them active! The explanation is that, with the plentiful rain, volcanic ash and lava quickly turn into fertile soil. The Jawanese are prepared to risk the danger from volcanoes in order to cultivate it. Jawa and other Indonesian islands produce a great variety of crops including the staple food rice, sugar, coffee, tea, cocoa, rubber and tobacco.

Rubber is a leading export of Indonesia, which is the world's second largest producer after Malaysia. Indonesia is also a major exporter of tropical hardwoods, including teak and ebony. Its important mineral exports are petroleum and tin. Its biggest oilfields are in Sumatera, Kalimantan and Jawa. Indonesia has developed some manufacturing industries and has textile mills and factories that process agricultural products. It also has oil refineries on Sumatera and Jawa.

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SOUTHERN ASIA

Farmland in the Deccan, the vast plateau region that covers much of central and southern India.

The Land

The towering Himalayas form the northern border of India, Bhutan, Nepal and Pakistan. The range extends westwards, as the Hindu Kush, into Afghanistan. To the south lie the highly fertile Northern Plains. They extend for more than 2,500 km (1,550 miles) and are some 300 km (190 miles) wide. They contain the flood-prone valleys of the great rivers flowing from the Tibetan Plateau. East to west these rivers include the Brahmaputra, Ganges, Sutlej and Indus. The Ganges empties into the Bay of Bengal through a vast delta region, which is one of the most populated areas in the world. East of the Indus, straddling the Pakistani–Indian border, is the hot, sandy Thar Desert. It covers 250,000 square kilometres (100,000 square miles).

On the western and eastern coasts of India are mountain ranges. The Western Ghāts, on the western coast, forms a narrow chain up to 1,500 metres (5,000 feet) high. The Eastern Ghāts, along the eastern coast, rise to a maximum of about 600 metres (2,000 feet). Between the Western and Eastern Ghāts lies the Deccan, the great triangular plateau of southern India. Its many rivers include the Godāvari, Krishna and Cauvery. They all flow eastwards into the Bay of Bengal. These rivers almost disappear in the dry season, but flood the land in the wet season. The Deccan is separated from the great Northern Plains by ranges of low mountains. They include the Vindhya Range, to the north-west, which rises to 1,200 metres (4,000 feet).

Sri Lanka (formerly Ceylon) is separated from India by the Gulf of Mannar. It is almost joined at one point by Adam's Bridge (a chain of 'stepping stone' islands). Sri Lanka is pear-shaped and rises from a low coastal plain to reach more than 2,500 metres (8,200 feet) in the south-central area. Several small rivers flow seawards from this high ground.

The Climate

The Indian subcontinent has a climate dominated by the monsoon winds. It has a wet season and a dry season. The wet season lasts from June to September. Moisture-laden south-west winds sweep inland from across the Indian Ocean. They bring heavy rainfall to most of the region. During the rest of the year the monsoons blow from the north or north-east. This is the dry season. However, even in the dry season rainfall is fairly heavy in Sri Lanka, Assam and Bangladesh.

An enormous variation occurs in the average annual rainfall across the subcontinent. In the Thar Desert less than 100 millimetres (4 inches) may fall in a

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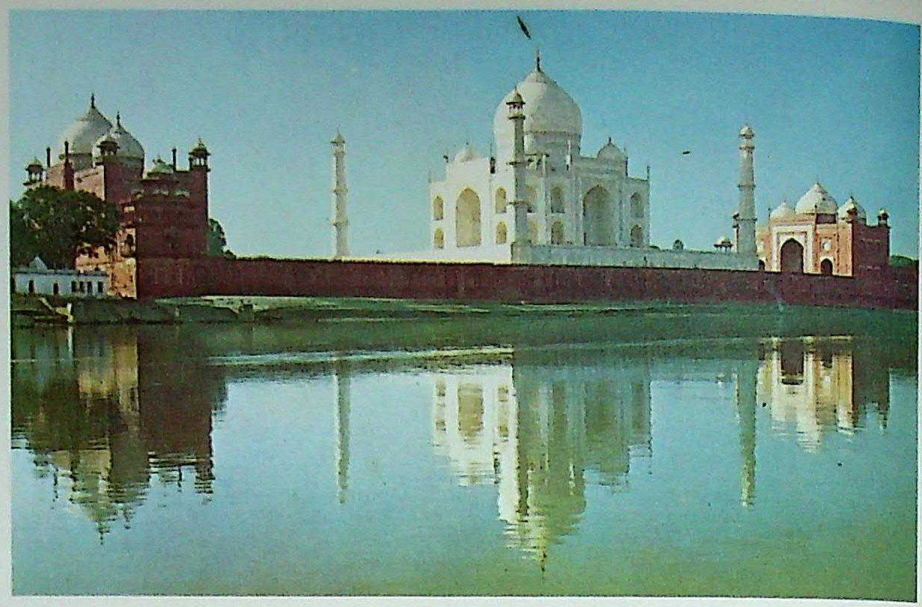
year. Yet Cherrapunji, in Assam, can receive 100 times as much.

The coast of Bangladesh, at the northernmost point of the Bay of Bengal, is especially subject to *cyclones*. These are destructive tropical storms, which are called typhoons in the Pacific. A disastrous cyclone hit Bangladesh (then East Pakistan) in 1970. It brought flood, famine and disease that killed 500,000 people.

Temperatures also vary over the subcontinent. In tropical India and Sri Lanka they are fairly even throughout the year (18–27°C, 64–81°F). On the Northern Plains the contrast between summer and winter is great. In summer the Plains may experience temperatures approaching 50°C (122°F). Yet in winter the temperatures may reach freezing point. In coastal regions the temperatures are less extreme.



India's most famous monument, the Taj Mahal, at Agra, built by Shah Jahan as a tribute to his favourite wife Mumtaz-i-Mahal.

Life of the People

More than four-fifths of the 800 million people of the Indian subcontinent live in the region's million villages. Farming is the chief occupation of the people. Only in a few centres has industry developed. Even so, the region contains some of the world's biggest cities. They include Calcutta ($7\frac{1}{2}$ million), Bombay (6 million), Delhi (4 million), Karāchi ($3\frac{1}{2}$ million), Madras ($2\frac{1}{2}$ million), Lahore ($2\frac{1}{4}$ million). Excepting Karāchi and Lahore, all these cities are in India. India in fact has about one-sixth of the world's population.

The pattern of life is fairly similar throughout most of the region, except in the arid north-west. Here, especially in Afghanistan, the pattern of life is nearer that of South-West Asia. On average in southern Asia about 150 people live in each square kilometre (400 per square mile) – twice as many as in South-East Asia. The most densely populated areas of the subcontinent are the fertile Northern Plains. In Bangladesh as many as 550 people live in each square kilometre (1,400 per square mile).

India is gradually becoming more industrialized. This plant in Bombay produces petroleum chemicals.

Throughout most of the subcontinent there is a distinctive style of dress. Most women wear a brightly patterned *sari*, which is thrown over one shoulder. They also wear a blouse-like garment, called the *choli*. Many men wear the *dhoti* – a white cloth wrapped between the legs and often extended to cover part of the upper portion of the body. Some wear turbans. In the cities, however, many men now wear Western dress or a modified form of it. Sikh men wear Western dress with the distinctive turban demanded by their religion.

Punjabi women often wear thin, baggy trousers under a short dress-like garment. In Muslim Afghanistan and Pakistan, some women wear a garment with small eyeholes that covers them from head to toe.

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The people of southern Asia are among the world's poorest. With the exception of Pakistan, the average income of each person is less than 2 American dollars a week. In the villages, however, few people starve. The most desperate kind of poverty occurs when villagers move to cities like Calcutta, Bombay and Karāchi seeking to improve their lives. If they cannot find work, they quickly become destitute.

Perhaps the greatest single factor in keeping the subcontinent poor is the rapidly expanding population. In 1976 nine Indians had to be fed from the same amount of land that fed five one generation earlier (in 1947). India's government, like those of several other Asian countries, is making great efforts to persuade parents to limit their families to two children. Only by restricting the size of the population can poverty be reduced.

However, the subcontinent is gradually changing. Extreme poverty is diminishing, food production and industrialization are increasing. Harmful customs and ideas are dying out as education becomes more widespread.

India

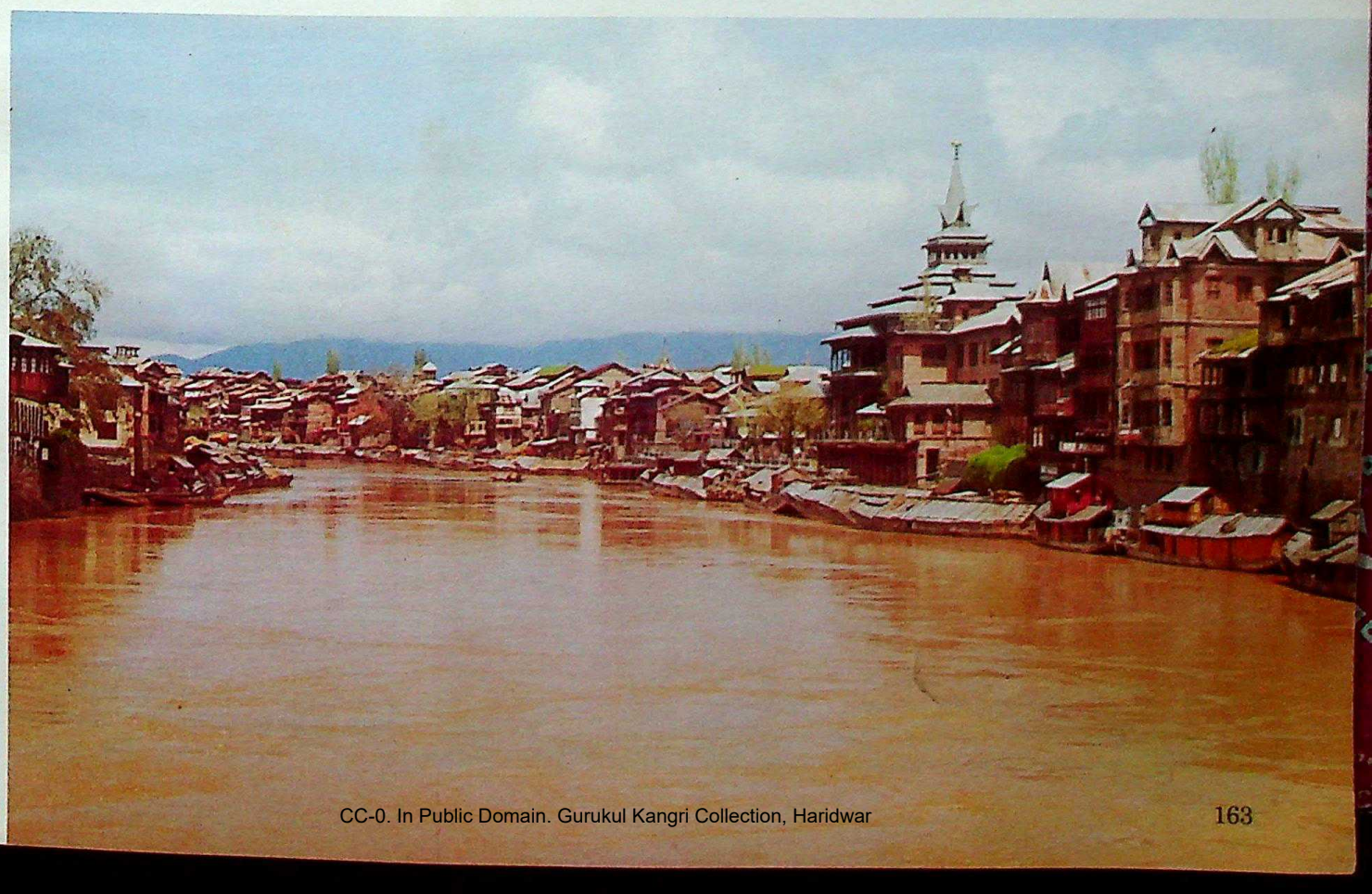
Most of the people of India belong to the Caucasoid race. In the north they are mainly Aryans, who are tall and have light-brown skins. In the south they are mainly Dravidians, who are shorter and darker. One of the main Dravidian groups are the Tamils, many of whom have migrated to Sri Lanka and south-east Asia. In the mountainous north of India the people are of Mongoloid origin.

The bond that has united Aryans and Dravidians in India is the Hindu religion. This plays a most important part in everyday life. Each Hindu is born into a particular *caste*, or division of society. In the past, caste decided a Hindu's job and status in society. Caste discrimination is now illegal, but it has not yet quite disappeared. Four-fifths of all Indian are Hindus. Most of the rest are Muslims.

As many as 60 different languages are spoken in India. Those of northern India belong to the Indo-European family of languages. They include Hindi, the official Indian language, and the related Urdu. Hindistani is a simpler form of spoken Hindi and Urdu. The languages of southern India belong to the Dravidian language group.

As elsewhere on the continent, farming is the chief occupation of the people. In general farmers use primitive methods of tilling and cultivating the land. In recent years, however, more and more farmers are using modern machines and techniques to improve production. India grows vast amounts of wheat and rice, particularly in the well-watered, fertile soil of the Northern Plains. Other major crops grown in this region are cotton, jute, sugar cane, tobacco and numerous vegetables. India leads the world in the production of tea, which is grown in Assam and elsewhere. Darjeeling is a famous tea centre.

Most Indian farms are tiny. On average they cover about 2 hectares (5 acres), though many are less than 1 hectare (2½ acres). By comparison an average American farm covers about 150 hectares (371 acres). After independence (1947) the Indian government tried to speed land reform so that



Srinagar, the summer capital of Jammu and Kashmir, lies on the Jhelum river in Kashmir.

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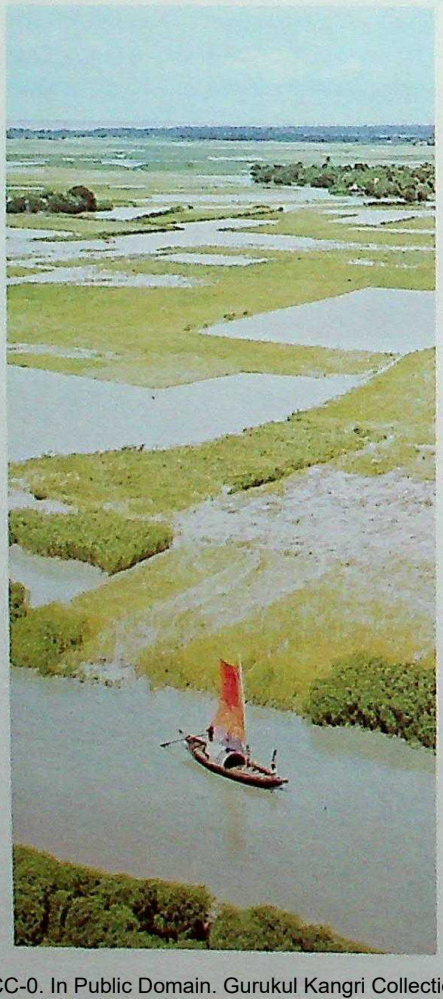
farmers could own their own land. However, many continued to pay rent that they could ill afford. They also had to borrow money at high rates of interest when they needed to buy seeds or farm implements. Many were born into debt and remained debtors all their lives. Life offered more promise for them from 1976, when the Indian government set up special banks to lend them money on reasonable terms. Tradition often hampers progress in India. India has the largest number of cattle in the world – more than 180 million. Yet they contribute very little to the economy. Cattle are sacred animals to Hindus, and are allowed to wander freely. They consume food but produce little or no milk. Also they cannot be slaughtered to provide meat, even though the people are desperately in need of food. Cow dung, which ought to be used to fertilize the farmland, is dried and burned as fuel.

Despite its poverty, India has the resources to be a rich nation. It has sufficient fertile land and large reserves of valuable minerals, including coal, mica, iron, aluminium and manganese ores. Most of India's 650,000 miners extract coal, which accounts for three-quarters of the value of all income from mining. India has in the Deccan probably a quarter of the world's known iron-ore deposits, although it extracts less than a twentieth of the world's supply. However, India's iron and steel industry is expanding rapidly. It is centred around Jamshedpur to the west of Calcutta. Jamshedpur has one of the world's largest steel mills. At Sindri is the largest chemical fertilizer plant in Asia. India manufactures its own vehicles and aircraft and has the largest rail network in Asia. Hydroelectric plants have been built to control floods and produce electricity for industry and the home. Electricity is now also being produced from nuclear power stations.

However, although industrialization has accelerated since independence, it is at a low level for a nation of over 600 million

Above: Contrasting means of transport in Colombo, capital and chief port of Sri Lanka.
Below: In Bangladesh, the rich plains of the Ganges river are ideal for growing rice.



people. In India less than 1 person in a 100 works in manufacturing industries, as against 10 in a 100 in the United States and 15 in a 100 in Britain. Many of the workers still work in traditional industries, such as textiles. Calcutta is the centre of the jute industry; Bombay is the cotton centre. Both are major ports.

Pakistan and Bangladesh

Until 1947 India, Pakistan and the region that is now Bangladesh were one nation – India. This nation was partitioned, or split, in 1947 into West Pakistan (now Pakistan), India and East Pakistan (now Bangladesh). Pakistan broke away from India because its people were mainly Muslims, who did not wish to be outnumbered by Hindus. The Pakistani and Bangladesh people therefore follow much the same way of life and have the same origins as the Indians.

Much of Pakistan is covered by mountains or rugged plateaux. On the north-west frontier with Afghanistan is the famous Khyber Pass. The main river of the country is the Indus, which rises in the Himalayas to the north of Pakistan. The new capital of Pakistan, Islāmābād, has been built near Rāwalpindi at the foot of the Himalayas. The Indus

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valley is a fertile region, where wheat and other cereals are grown, together with cotton and jute, sugar cane and tobacco. Jute and cotton are major exports.

Karāchi is the largest city in Pakistan, near the Indus delta. Once the capital of Pakistan, it is an important seaport and industrial centre. It has a large oil refinery and a nuclear power station. The second largest city, Lahore, is noted for its textile industry. It has several beautiful mosques and palaces and the famed Shalimar gardens.

In Bangladesh the most important crops are rice, jute, cotton and tea. The world's largest jute mill is at Nārāyanganj, near the country's capital, Dacca. Bangladesh's main seaport is Chittagong.

Sri Lanka

More than two-thirds of the Sri Lankans are Sinhalese people. Their ancestors came from India and mixed with an earlier people called Veddahs. The Sinhalese retained Buddhism after that religion died out in India. Most other Sri Lankans are Tamils, who came from India to work on the tea and rubber plantations. Several small groups descended from Arabs, Malays and Europeans. They follow Islam and Christianity.

Most Sri Lankans work on the land. They grow crops such as rice, tobacco and cotton on the fertile lowland plains, and also grow rubber trees and coconut palms there. The climate is hot and humid, for the island lies between 6 and 10 degrees north of the Equator. On the mountain slopes of Sri Lanka's interior grows the country's most important crop – tea. Sri Lanka is second only to India in tea production, and tea is vital to the country's economy. The mining industry in Sri Lanka is small, but profitable. It produces the world's best graphite and precious and semi-precious stones such as sapphires, rubies, aquamarines and zircons. Most other industries process tea, rubber and coconuts.

Nepal and Bhutan

In the extreme north of southern Asia is the small mountainous kingdom of Nepal. It was almost as isolated as Tibet until roads and an airport began to be built in the 1950s. Practically all of Nepal lies in the Himalayas. Kātmāndu the capital is the only large city. Practically all the working people work on the land, cultivating the lower slopes and valleys. They grow such crops as wheat, maize and lentils, and also keep cattle.

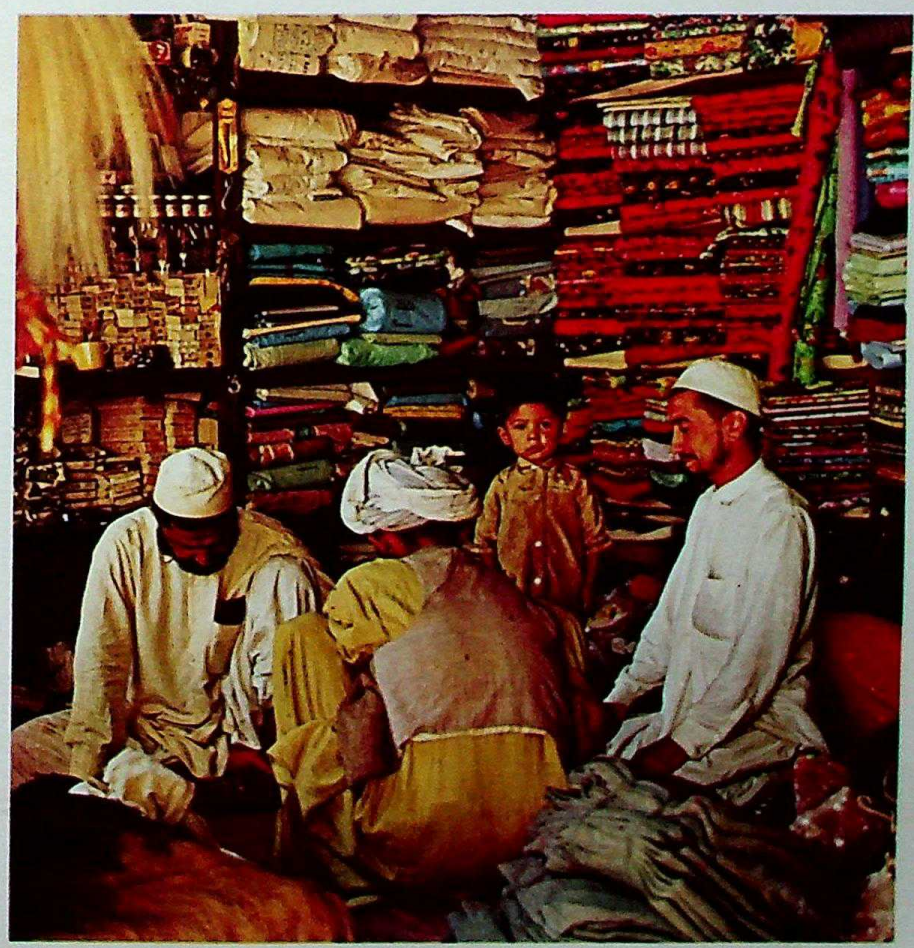
The main groups of Nepalese are the Gurkhas, Newars and Sherpas. The Gurkhas form the ruling class and are noted as soldiers. The Sherpas are farmers, but are world-famous for their mountaineering exploits. They often act as guides and porters for Himalayan expeditions. Hinduism and Bhuddism are the main religions.

To the east of Nepal is the even smaller country of Bhutan. It is very mountainous and heavily forested. Farming is possible in the valleys and is centred on the many *dzongs*, fortified Buddhist monasteries. Thimbu is the capital and only important city.

Afghanistan

Afghanistan was the land from which most invaders swept into India. About half the 19 million Afghans are Pathans. They are tall people of light-brown complexion, similar to Pakistanis. Others include Mongoloid Tadzhiks and Uzbeks. Almost all Afghans are Muslim.

Most of the country is barren and infertile, being covered by mountains, marshes and deserts. Only in the river valleys is the land suitable for farming. Wheat and other cereals, cotton, spices, tobacco, fruit and nuts are important crops. Livestock such as sheep and goats are farmed in some areas, but most livestock are kept by nomadic herdsmen who roam the countryside. There is virtually no industry.



Covered markets, like this one in Gilgit in northern Pakistan, can be found throughout the East.

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SOUTH-WEST ASIA

The Land

South-West Asia is made up of Turkey, Iran and Arabia. In Northern Arabia are Syria, Lebanon, Jordan, Iraq and Kuwait, together with the Jewish state, Israel. The remainder of Arabia is taken up mainly by Saudi Arabia, which occupies practically the whole of the Arabian Peninsula. The peninsula is bounded on the west by the Red Sea, in the south by the Arabian Sea and in the east by the Persian Gulf and the Gulf of Oman.

Much of the land in the region lies less than 1,000 metres (3,300 feet) above sea level. But there are several mountain systems. In the north mountain chains extend from southern Turkey to near the Caspian Sea and then south-west to cover much of Iran. They include the Turkish Pontine and Taurus ranges and the Zagros mountains of western Iran, which extend east of the Persian Gulf.

Iran lies mainly on a plateau above 1,200 metres (4,000 feet), surrounded by mountain chains. East of the Zagros are the Central Mountains, which cover nearly a quarter of Iran. In the long and narrow, but fertile valleys of these mountains live most of Iran's people. The forested Elburz Mountains, south of the Caspian Sea, contain Iran's highest peak, Mt Damāvand (5,774 metres, 18,943 feet). In central Iran are two large, almost uninhabited deserts. They are the Dasht-e Kavīr, a salt desert, and the Dasht-e Lūt, a sand desert.

Iran has a narrow strip of fertile, low coastland south of the Caspian sea, which lies more than 25 metres (82 feet) below sea level. In the south of Iran north of the Persian Gulf is another low-lying region – the Khūzestān Plain. In this region are Iran's richest petroleum deposits. Several rivers flow from Iran's mountains into the central plateau, where most dry up.

Turkey's coastland is washed by three seas: the Black Sea in the north, the Aegean in the west and the Mediterranean in the

Irrigated farmland near Ma'lula, in Syria. Irrigation is practised throughout most of Syria, where rainfall is scant.

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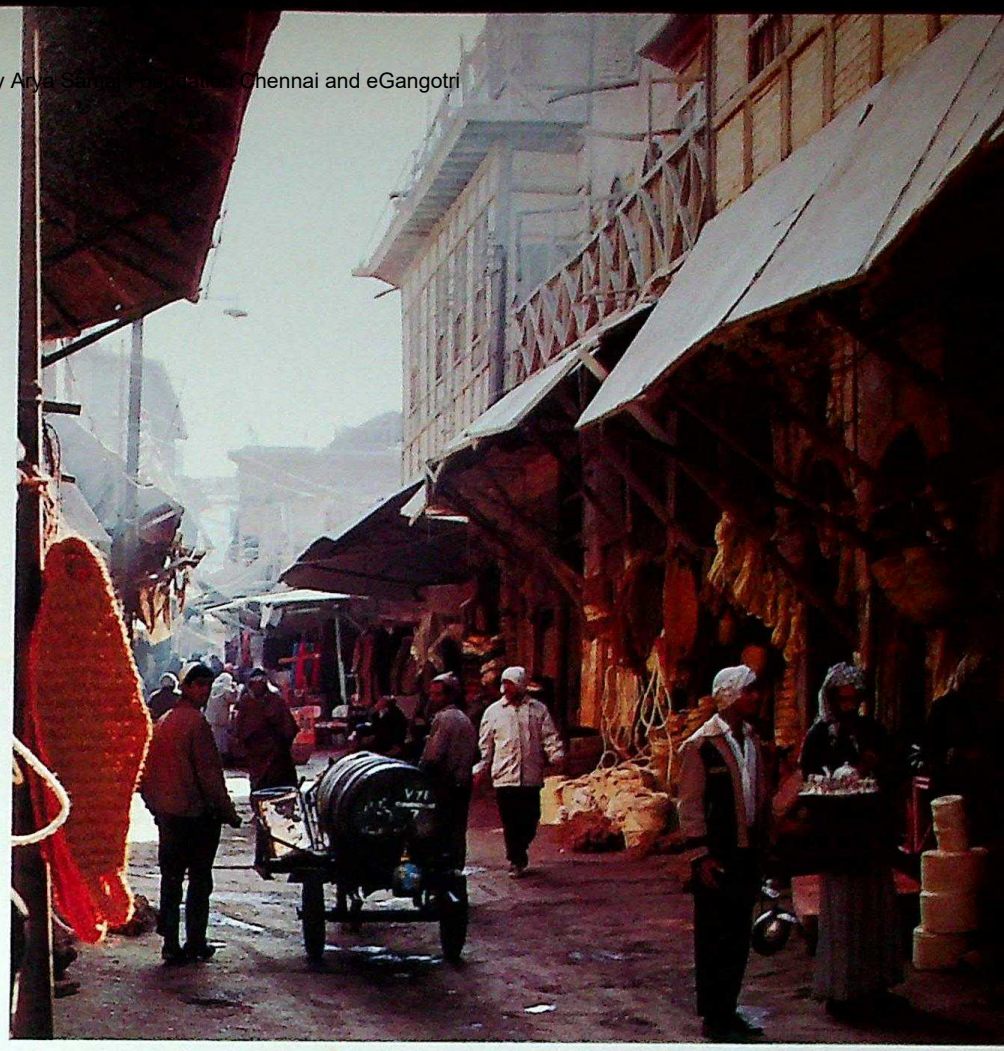
south. Most of Turkey is in Anatolia, a rugged, semi-desert plateau, which lies up to 2,000 metres (6,500 feet) above sea level. The Anatolian region is often subject to earthquakes, which have killed tens of thousands of people this century. In this region is the Anatolian fault in the Earth's crust. It marks the boundary between two of the blocks, or *plates*, which make up the crust. Movement of the plates causes the earthquakes (see page 56). The Sea of Marmara separates European and Asian Turkey. It links northwards to the Black Sea through the Bosporus and southwards to the Aegean Sea through the Dardanelles. These waterways have been of great importance in Turkey's history.

About 65 km (40 miles) south of Turkey, in the extreme north-east of the Mediterranean, lies the rugged island of Cyprus. The wooded Troodos mountains cover much of western Cyprus. The highest peak is Mt Olympus (1,953 metres, 6,407 feet). To the north is the lower Kyrenia range. Between these two ranges lies the flat Mesaoria Plain, where there is much irrigated farmland.

Most of Arabia is covered by dry, sand deserts, where scarcely anyone lives. The vast Rub al-Khālī desert in the south of the Peninsula is often called the 'Empty Quarter'. Most Arabs are now settled in towns or oases, but up to two million Bedouin still wander across the wasteland from oasis to oasis.

The Arab countries in the north – Syria, Lebanon, Iraq, Jordan and Kuwait – cover only one-fifth of Arabia. But they have more than three-fifths of its population. Most of Iraq's people live either along the fertile valleys of the Euphrates and Tigris rivers or along the coast of the Persian Gulf. The Euphrates–Tigris region was one of the 'cradles' of early civilization. It is often called Mesopotamia, meaning 'between the rivers'. The population of Syria, Lebanon and Jordan is concentrated near the Mediterranean coast and along the Jordan River to the Dead Sea. This is a very salty lake in which only a few plants can live.



A market in Basra, Iraq's chief port, on the Shatt al Arab river near the Persian Gulf.

The main mountainous region in Arabia is along the western coast bordering the Red Sea. In the South is the Asir range, which rise to 3,760 metres (12,336 feet) in Yemen. The northern part of this region is occupied by the Hejaz mountains, which rise to more than 1,500 metres (5,000 feet) near the Gulf of Aqaba.

The same mountain system continues more or less due north through Jordan, Israel, Lebanon and Syria and into Turkey. The highest peak is in the Lebanon Mountains. It is Qurnat as-Sawdā' (3,088 metres, 10,131 feet).

Long ago, Arabs pushing northwards from the Arabian desert entered a relatively fertile, semi-circular belt that extended from the Mediterranean coast, north-east, north and then south-east along the valleys of the Euphrates and Tigris. They marvelled at the tall palms and well-watered grassland that they found there, and called the area the 'Fertile Crescent'. Part of Israel lies in the Fertile Crescent. Other desert regions in Israel have now been made fairly fertile by man-made improvements, such as extensive irrigation.

The Climate

Lack of precipitation – rain, snow and so on – is the main feature of the climate of South-West Asia. As a result most of the area is desert. In the desert regions summer temperatures are very high indeed. In the interior of Saudi Arabia, for example, temperatures can soar to more than 50°C (122°F) by day. At night, however, even in summer, the temperature falls sharply. In winter night-time temperatures may drop to near freezing point. In coastal regions the temperatures are lower and vary less from day to night. One feature of the coastal regions of Arabia is their very high humidity, which is very tiring to work in.

Rainfall in the desert regions is very low. On average less than 100 millimetres (4 inches) falls

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A Bedouin outside his tent in southern Yemen. Bedouins are the nomads of the deserts.

every year. In some parts rain may fall only once every three or four years. Rainfall in other areas of South-West Asia is higher. In Lebanon, on the Mediterranean, as much as 1,000 mm (40 inches) may fall in a year. A similar amount may fall on the coastal plains of Turkey and in northern Iran. Most of Turkey and Iran, however, have much less rain.

Life of the People

Many parts of South-West Asia have seen greater changes in the past 30 years than any other places in the world. Kuwait and the United Arab Emirates, for example, have been transformed. Prosperous towns now stand where Bedouins once scratched a bare living by pasturing their animals on desert grasses.

The discovery and exploitation of petroleum has been the sole reason for this 'miracle'. South-West Asia has less than one-thirtieth of the world's people but it produces more than a third of its crude oil. Between 1972 and 1974 the world's oil-supplying countries raised the price of oil nearly fourfold.

South-West Asia's chief oil-producing countries, in order of importance, are Saudi Arabia, Iran, Kuwait, Iraq, United Arab Emirates, Qatar, Oman and Bahrain.

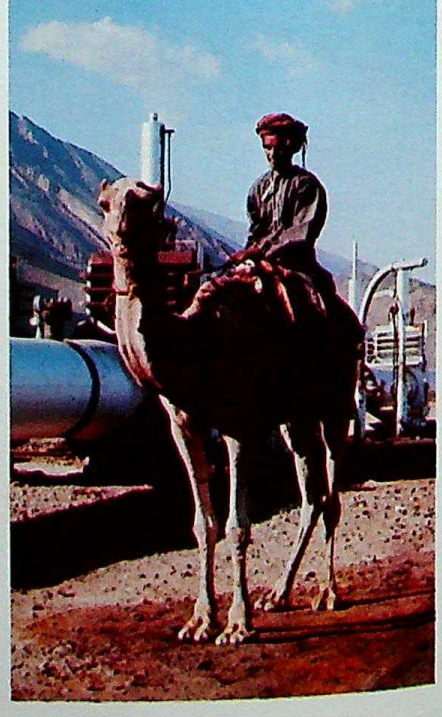
In Iran the average income from exports per head of the population increased from 90 American dollars in 1970 to 770 dollars in 1974. The Iranian government has begun to use much of this enormous income to transform Iran from an undeveloped agricultural country into a leading industrial nation. Like other Middle East governments, it knows that the oil reserves will one day come to an end. Then Iran will have to live on what it can produce in its farms and factories. Some countries, like Kuwait, have set up a welfare state for their citizens, with free education, health and social security. Kuwait abolished income tax, and its citizens joined the world's wealthiest people. They have an average annual income of over 4,000 dollars each.

With much of the new income being invested in long-term planning, however, the old way of life still continues. Although few Arabs remain *Bedouins* (nomads), most workers are still farmers. The oil industry itself does not directly employ many people. However, trucks are now a more common sight than camels.

Unlike southern Asia, South-West Asia has no problem of over-population. On average there are less than 20 people to each square kilometre (50 to the square mile). An Iranian has ten times as much space as an Indian, and an Arab 16 times as much. The only big cities in South-West Asia are Tehrān ($3\frac{1}{4}$ million), the capital of Iran; Baghdād ($2\frac{3}{4}$ million), the capital of Iraq, and Ankara ($1\frac{1}{2}$ million), the capital of Turkey.

The dominant religion in every part of the region (except Cyprus and Israel) is Islam and many women follow the Muslim practice of veiling their hair and faces. Some wear a *qamis*, which is a black or blue garment that covers the whole body. Many Arab men still wear the traditional *galabiyah* (robe) and a headdress held in place by an *iqal* (thick, twisted cord). Some wear a *fez*, or *tarbush*, which is a red felt hat with a black tassel. Others wear Indian-style turbans. In Iran, country dwellers may dress more in central Asian style. Men wear many long robes rather tighter than the galabiyah, and close-fitting skull caps. But increasingly, many are wearing western dress.

An Omani tribesman poses before a pipeline that carries oil from his country's rich oil-fields.



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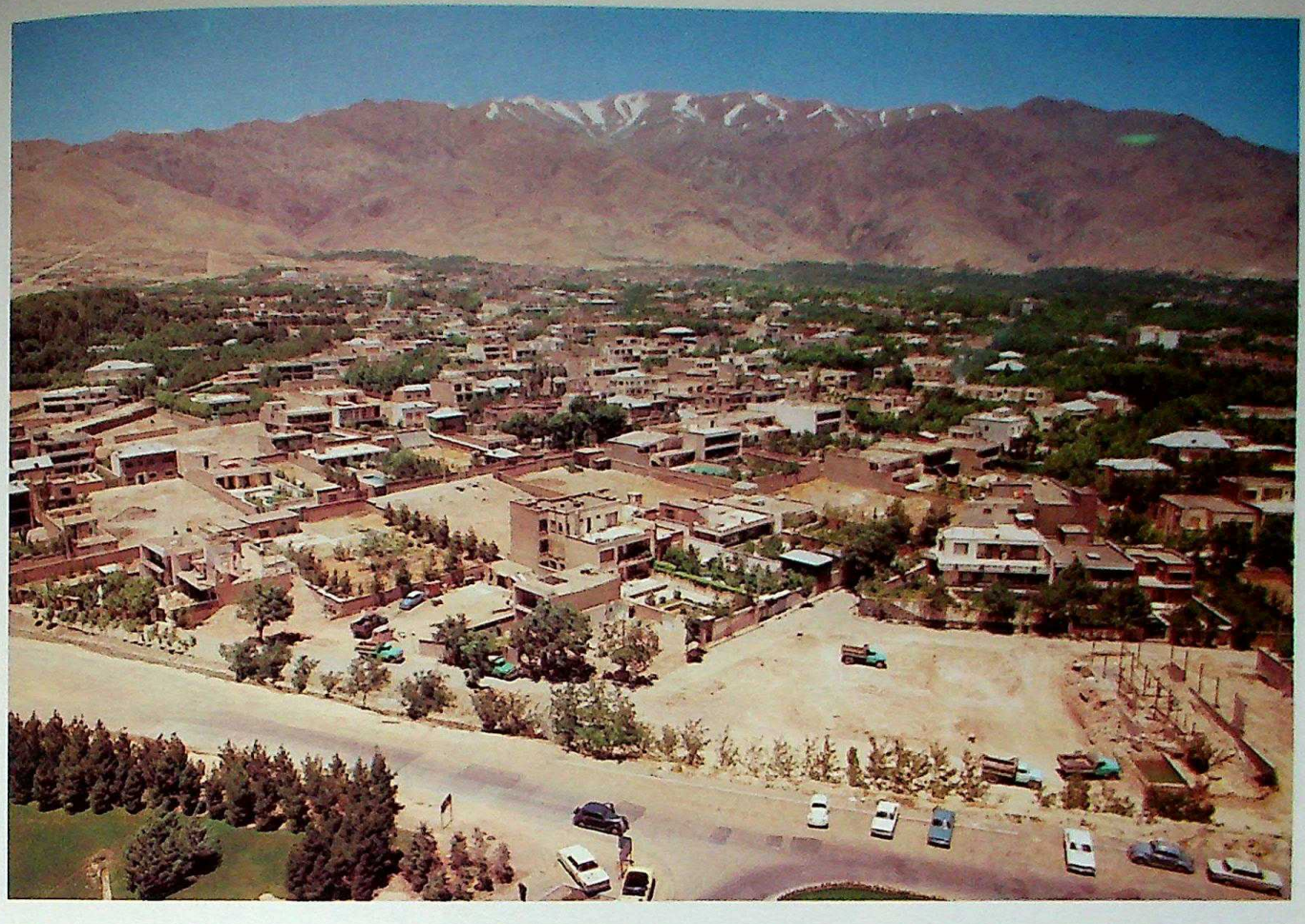

Tehran, the capital of Iran, is a spacious, beautiful city, set in the foothills of the snow-capped Elburz Mountains.

Outside the cities, poor people often live in mud-brick buildings rather like those in Indian villages. In Syria, Iraq and Iran these may have domed roofs. Every dwelling place has its mosque, no matter how simple. Most cities have large mosques of great architectural beauty. In Iraq and Iran these are often covered with beautiful tiles.

Turkey and Cyprus

The Turkish people came originally from central Asia, they are closely related to the people who live in Afghanistan, Iran and South-East Russia, such as Uzbeks and Turkmens. There is also a small Kurdish group, who are tribesmen from Iraq and Iran.

Three out of every five Turks live in country areas. Turkey's only really big city, Istanbul, is located in Thrace – the small, north-west corner of Turkey that lies in Europe. The largest city in Asian Turkey (Anatolia) is the capital Ankara.

The Anatolian Plateau is Turkey's main farming region, where wheat and other cereals and sugar beet are grown. Poppies are another important crop. They are cultivated to produce the drug opium. Figs, olives and other fruits are grown, mainly in the south-west. Tobacco and cotton are also grown in coastal regions. Sheep and goats are the most important livestock raised. Goats of the Angora breed are raised for their fine hair, which is made into mohair.

Although Turkey is mainly an agricultural country, it has important mining and manufacturing industries. It is, for example, one of the world's largest chromium producers. It also has extensive coal-mines, at Zonguldak on the Black Sea coast. Steelworks have been built in the same region, and other heavy industries have been built up. The textile industry is also important. It is centred on Adana, near the Mediterranean coast.

Muslim Turks form only about one-fifth of the small population of Cyprus. The remainder are Christian Greeks. In the early 1970s war between the two groups destroyed the normal pattern of life on the island.

Iran

The country of Iran used to be called Persia. In 500 BC it was the centre of a vast Persian Empire, which ruled all of South-West Asia and parts of Europe. In the AD 700s it was the centre of Muslim learning. But it gradually lost its wealth and power. In recent years it has regained wealth, and power, due to its abundant petroleum deposits.

Petroleum, in fact, now dominates the economy of Iran. Income from petroleum is being used to develop both heavy and light industries. Most factories are state-owned. The centre of the oil industry is Abādān, on the Persian Gulf, where there is one of the world's largest oil refineries. Among the more traditional

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Ploughing a hillside in Cyprus in a manner that has not changed for centuries. Note the odd combination of donkey and heifer pulling the wooden plough.

industries is textiles manufacturing. The main products are the beautiful hand-made Persian carpets, which are famous throughout the world. They are expensive because they may take years to make. Often the work is done by children.

Much of Iran's land is too mountainous or too dry to farm. Only about one-sixth of the area can be used for crop growing. Wheat and barley are the main crops. Rice, cotton, maize, sugar beet, tobacco, poppies and a variety of fruits are also grown. Livestock such as sheep and goats are kept by farmers and nomadic herdsmen.

The Arab Countries

The Arabs have always considered themselves to be one people, undivided from Africa's Atlantic coast to the borders of Iran. However, since 1922 the Arabs of Asia have become divided into a dozen different states. In order of size these include Saudi Arabia, Iraq, Southern Yemen, Oman, Yemen, Syria, Jordan, the United Arab Emirates, Kuwait, Lebanon, Qatar and Bahrain. Some have remained poor. But others, Kuwait for example, have been transformed by oil from poverty to wealth almost as speedily and magically as in the stories of the *Arabian Nights*.

Oil dominates the economy of most Arab states. Saudi Arabia, Kuwait and Iraq are the biggest Arab oil producers. In Saudi Arabia pipelines carry the oil from the producing fields to refineries and tanker terminals on the tiny island of Bahrain in the Persian Gulf. Large amounts of oil are piped across the desert to the port of Ṣaydā, in Lebanon. Pipelines also run to Mediterranean ports from Iraq's oil fields in the Kirkūk region in the north.

Farming in the Arab countries is in general very primitive. Cereals such as wheat and barley are grown on the larger oases and in fertile river valleys. Date palms and fig trees also thrive there. Iraq produces three-quarters of the world's dates. Cotton, rice and tobacco are also cultivated in some regions. So are citrus fruits such as oranges. The main livestock raised are camels, horses, sheep and goats. The one-humped Arabian camel is often called the 'ship of the desert', since it is widely used as a beast of burden in desert regions. It can go without water for a long time. Most sheep and goats are kept by wandering nomadic herdsmen. Traditional industries in the towns process farm products. They include textile manufacturing and making leather goods. Damascus (Dimashq), the capital of Syria, is a famous textile centre, which gave its name to the rich fabric called damask.

Israel and Lebanon

Palestine has been the traditional home of the Jews since Biblical times, but few lived there before 1900. However, many Jews migrated there between 1917 and 1948. In 1948 the Jewish state of Israel was set up. Although every Arab state has opposed the existence of Israel, the state has survived, despite four Arab–Israeli wars in 25 years. Helped by Jewish people living abroad, the Israelis have established a modern country in which the way of life is very European.

Farming in Israel is very advanced, and irrigation is widespread. Most farming is carried out collectively in a *kibbutz*. The people all work together and share in the income earned by their labour. Cereals such as wheat are widely grown, as are citrus fruits. Oranges are a major export. Industry is better developed than in the neighbouring Arab countries.

Lebanon is the 'odd man out' among the Arab countries for nearly half its people are Christians. Also, its prosperity has been built up by merchants and businessmen rather than by farmers or oilmen. However, it has become an important centre for the oil trade. As in Cyprus, the whole way of life in Lebanon was threatened in the 1970s by fighting between Muslims and Christians. In 1975/6 tens of thousands of people were killed in fierce fighting in the capital, Beirut (Bayrūt), alone.

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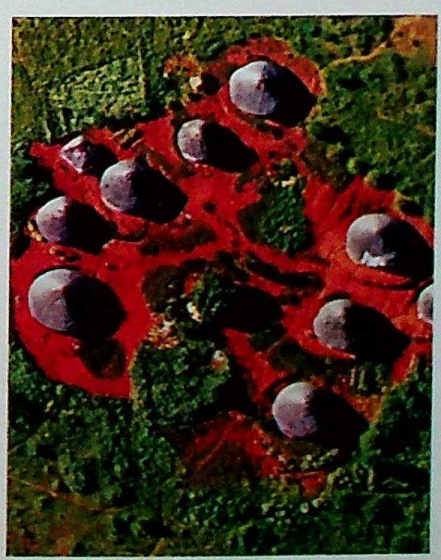
AFRICA

THE PEOPLES OF AFRICA

Africa is the second largest continent. Only Asia is bigger. Africa covers an area of more than 30,300,000 square kilometres (11,700,000 square miles). It is nearly three times as big as Europe and slightly more than three times as big as the United States.

In 1975 Africa had a population of about 396,000,000. On average there are only about 13 people to every square kilometre (34 per square mile). This is low compared with Europe and Asia. In Europe there are nearly five times as many people to every square kilometre. In Asia there are more than six times as many. The population is low because much of the land is unsuitable for settlement. Most of Africa lies in the tropics, where there are dense rain forests. There are also vast, hot deserts and other regions where the rainfall is too low for crop farming. On average about 70 out of every 100 Africans live in country areas, where they grow crops or keep herds of livestock. The largest cities, which are in northern and southern Africa, are Cairo and Alexandria in Egypt, Casablanca in Morocco, and Johannesburg in South Africa.

Africa now boasts many modern towns, such as Kenya's capital Nairobi (above). But many Africans still live in traditional native villages such as the Zulu kraal (below).



Whites and Coloureds

Today nearly all African countries are independent. Before 1960 only 10 were independent. All the others were ruled by European powers – Belgium, Britain, France, Portugal and Spain. Many Europeans have remained in Africa. The largest group of people of European origin live in South Africa. They came mainly from Britain and the Netherlands. The people of Dutch descent are called *Afrikaners*. They have their own language called Afrikaans, which is a form of Dutch. Other large groups of Europeans live in Rhodesia and in northern and eastern Africa.

People of Asian origin form another important group in eastern and southern Africa. Their ancestors went to Africa to work as skilled and unskilled labourers a century ago. In southern Africa there is quite a large Coloured population. Coloureds are people of mixed race. They may be part-African and part-European, or part-African and part-Asian.

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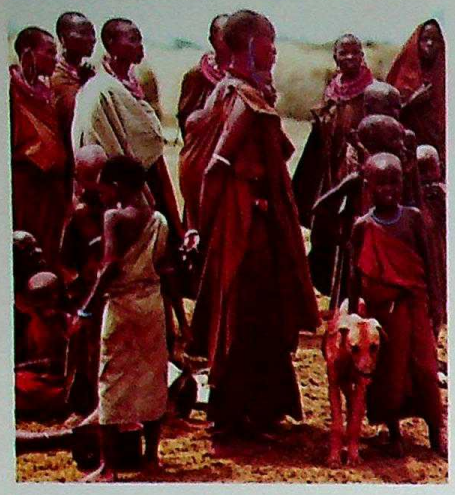

The Masai people of Tanzania and Kenya herd livestock and live off their milk and blood.

Black Africa

More than 1,000 separate black African peoples live south of the Sahara desert. Each has its own language. Most black Africans of central and southern Africa speak Bantu languages. These languages are quite similar, but a person speaking one Bantu language cannot understand a person speaking another. In Tanzania, for example, there are more than 120 different languages and dialects or local variations. Tanzanians of different language groups can talk to each other only through a second language, either Swahili or English. Swahili is a Bantu language which is fairly easy to learn. It is widely used as a *lingua franca* (common language).

The Bantu-speaking peoples are mainly poor farmers who grow only enough food for themselves and their families. The two largest Bantu groups are the Zulu and the Xhosa. They are very interesting because they make a clicking noise when they speak. They learned this way of speaking from the Bushmen and Hottentots. In dry areas, some Bantu groups keep herds of cattle and other animals, and live on their milk and blood. The Masai people of East Africa do this.

Three interesting minority groups live within the Bantu-speaking region. They are the pygmies of central Africa, and the Bushmen and Hottentots of

AFRICA

Country	Area Sq. Km.	Population 1975 est.	Capital
Afars and Issas	22,000	105,000	Djibouti
Algeria	2,381,741	16,798,000	Algiers
Angola	1,246,700	5,673,000	Luanda
Botswana	600,372	695,000	Gaborone
Burundi	27,834	3,600,000	Bujumbura
Cameroon	475,442	6,404,000	Yaoundé
Cape Verde Islands	4,033	295,000	Praia
Central African Republic	622,984	1,612,000	Bangui
Chad	1,284,000	4,024,000	N'Djamena
Comoro Islands	2,171	305,000	Dzaoudzi
Congo	342,000	1,053,000	Brazzaville
Dahomey	112,622	3,071,000	Porto Novo
Egypt	1,001,449	37,101,000	Cairo
Equatorial Guinea	28,051	307,000	Bata
Ethiopia*	1,221,900	27,076,000	Addis Ababa
Gabon	267,667	526,000	Libreville
Gambia	11,295	493,000	Banjul
Ghana	238,537	9,867,000	Accra
Guinea	245,957	4,412,000	Conakry
Guinea-Bissau	36,125	309,000	Bissau
Ivory Coast	322,463	4,876,000	Abidjan
Kenya	582,646	13,360,000	Nairobi
Lesotho	30,355	1,038,000	Maseru
Liberia	111,369	1,747,000	Monrovia
Libya	1,759,540	2,324,000	Bengasi; Tripoli
Malagasy Republic	587,041	6,750,000	Tananarive
Malawi	118,484	5,043,000	Lilongwe
Mali	1,240,000	5,604,000	Bamako
Mauritania	1,030,700	1,326,000	Nouakchott
Mauritius	2,045	891,000	Port Louis
Morocco	446,550	16,309,000	Rabat
Mozambique	783,030	8,823,000	Lourenço Marques
Namibia (South-West Africa)	824,292	702,000	Windhoek
Niger	1,267,000	4,504,000	Niamey
Nigeria	923,768	62,869,000	Lagos
Reunion	2,510	494,000	St Denis
Rhodesia†	390,580	6,332,000	Salisbury
Rwanda	26,338	4,202,000	Kigali
St Helena	122	5,000	Jamestown
São Tomé and Principe	964	81,000	São Tomé
Senegal	196,192	4,441,000	Dakar

(table continued overleaf)

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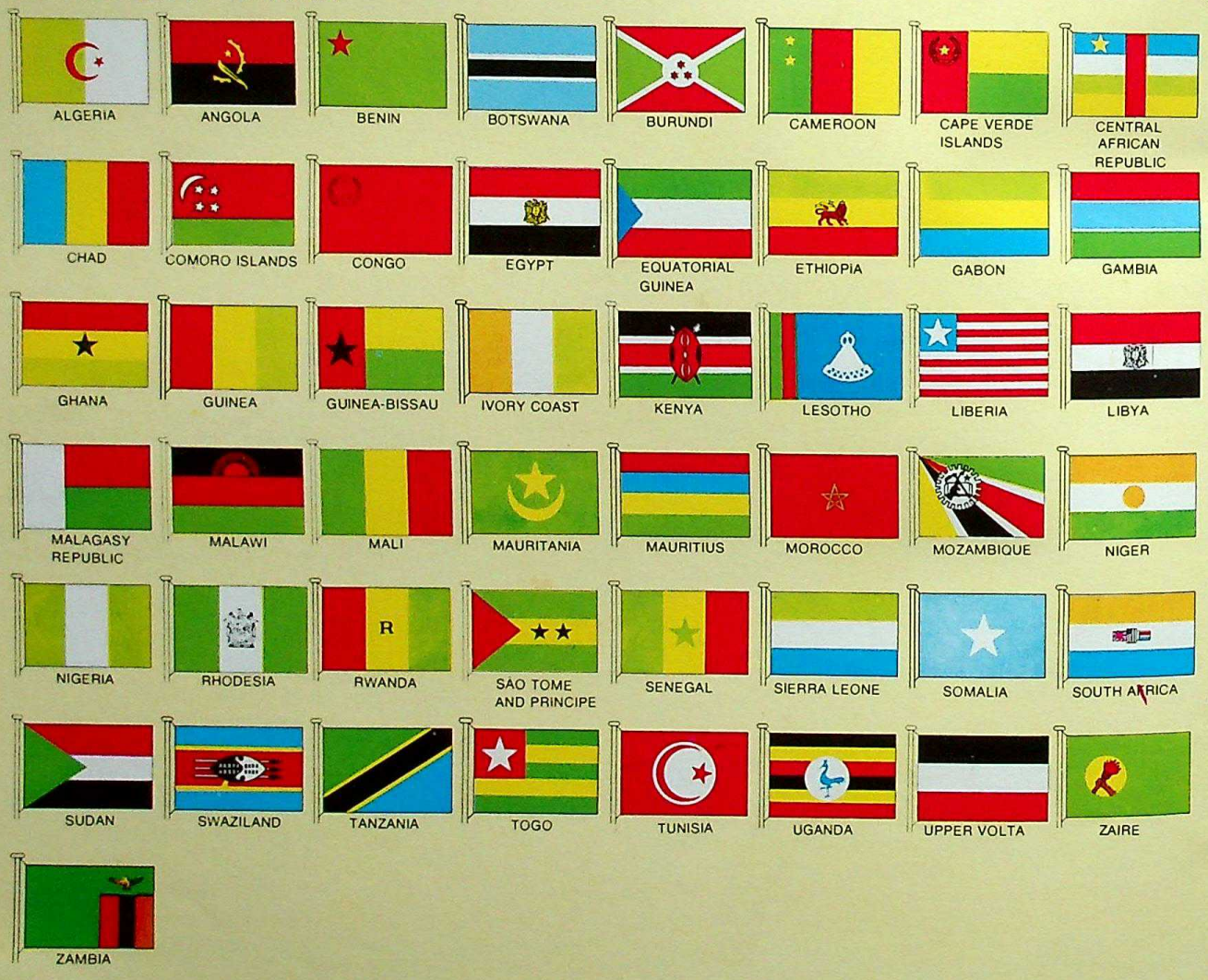
Country	Area Sq. Km.	Population 1975 est.	Capital
Seychelles Islands	376	59,000	Victoria
Sierra Leone	71,740	2,861,000	Freetown
Somalia	637,657	3,155,000	Mogadiscio
South Africa	1,221,037	25,071,000	Cape Town; Pretoria
Spanish Sahara	266,000	117,000	Aiún
Sudan	2,505,813	17,757,000	Khartoum
Swaziland	17,363	504,000	Mbabane
Tanzania	945,087	15,164,000	Dar es Salaam
Togo	56,000	2,220,000	Lomé
Tunisia	163,610	5,777,000	Tunis
Uganda	236,036	11,535,000	Kampala
Upper Volta	274,200	5,980,000	Ouagadougou
Zaire	2,345,409	24,901,000	Kinshasa
Zambia	752,614	4,965,000	Lusaka

southern Africa. The pygmies are very short people with brownish-yellow skins. Even when fully grown, the men are no more than about 142 cm (4 feet 8 inches) tall. Pygmies live together in small bands and exist by gathering food in the forests and by hunting and fishing. Their numbers are declining because they have intermarried with other peoples. The Bushmen and Hottentots were the first inhabitants of southern Africa. The Bushmen, who live in the Kalahari desert, are primitive hunters and gatherers. They have a fairly light reddish-brown skin. They are related to the Hottentots, who have an even paler, yellowish skin. The Hottentots were once wandering herdsmen. Only a few thousand Bushmen and Hottentots remain.

THE FLAGS OF AFRICA



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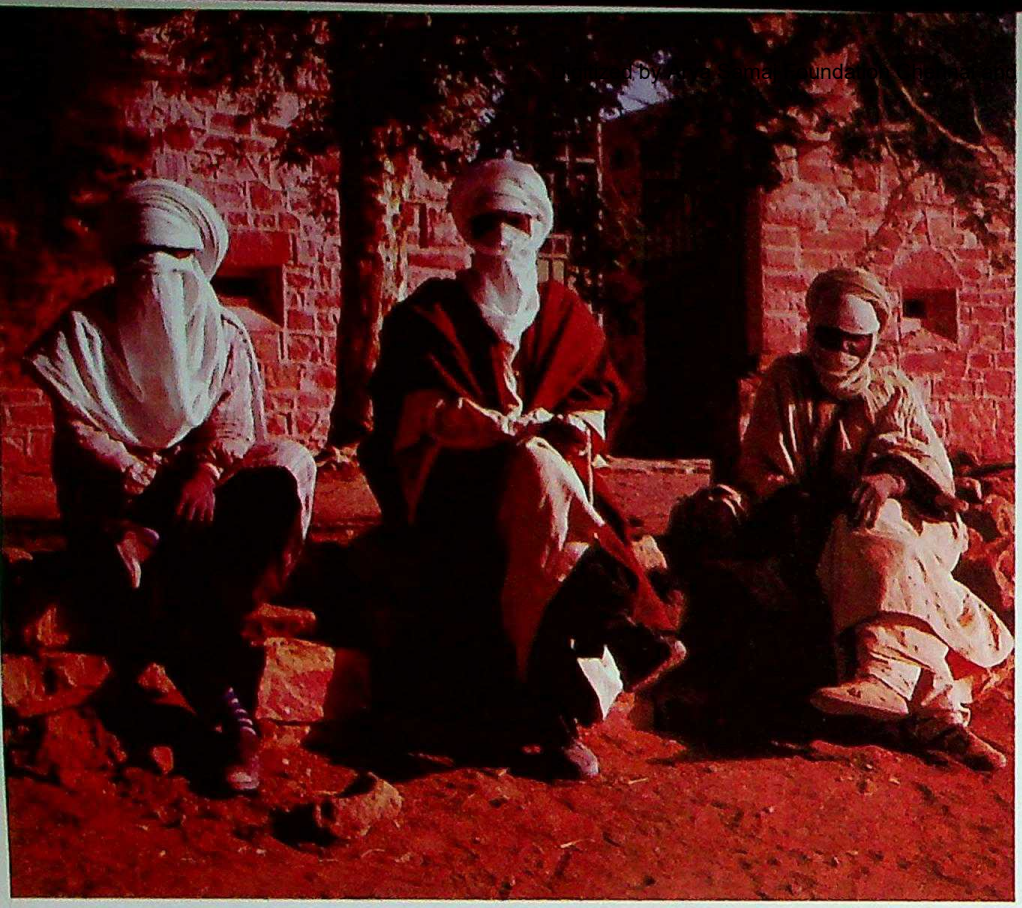


Tuareg tribesmen of the Sahara cover their faces with a long strip of cloth (above). Women of the Comores Islands (below) dress more colourfully.

The peoples of West Africa speak non-Bantu languages. They, too, are mainly farmers. Along the southern coasts of West Africa, the people farm clearings in the thick, tropical forests. To the north, the rainfall decreases and the forests thin out, and there are large areas of grassland and *savanna* (grass with trees). These regions support a large population, and there are many big towns.

Christianity is a common religion in much of black Africa. But many West Africans are Muslims, following Islam, the religion of the Arabs to the north. Other peoples have their own religions. They believe in one God, but they also believe in the power of spirits, especially the spirits of dead ancestors. Many believe that spirits live in trees. They sometimes hold religious ceremonies before they fell a tree to apologize for cutting it down. Stones and wild animals are also thought to have spirits living in them.

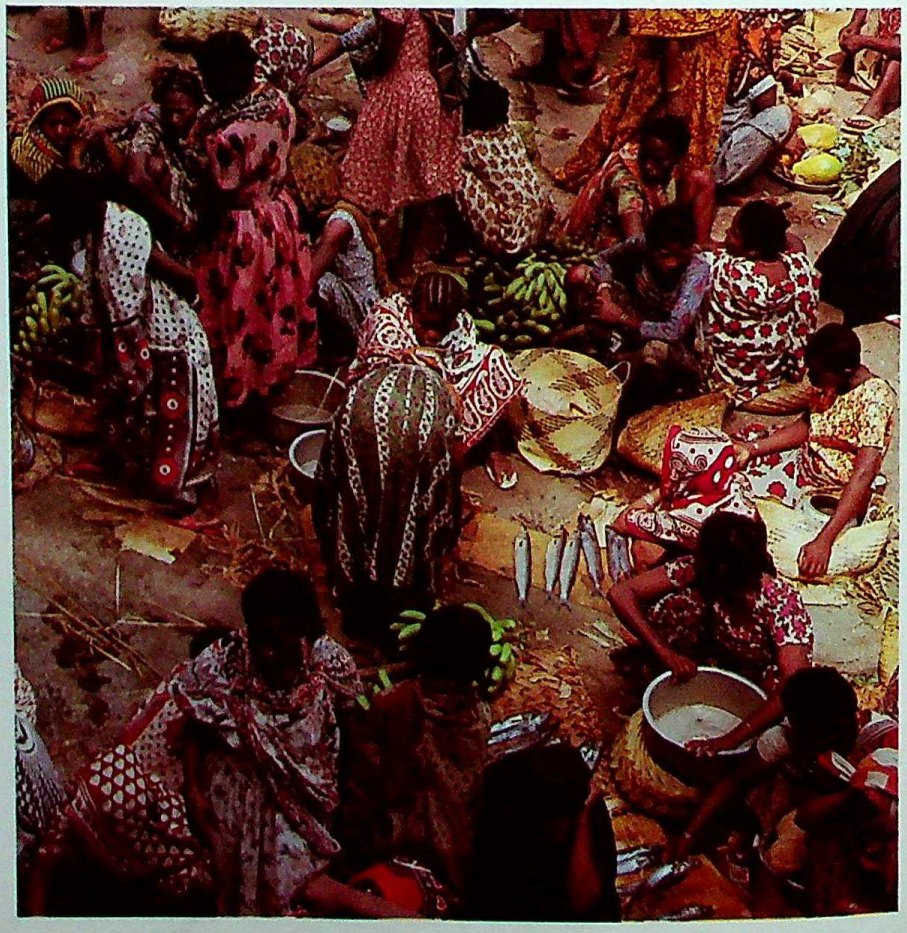
Northern Africa

The people of North Africa are mainly brown-skinned Arabs and Berbers. Traditionally, the Arabs were herdsmen and the Berbers were farmers. Today most Arabs and Berbers are farmers or work in towns. The most highly developed farming region in North Africa is in the fertile Nile valley, in Egypt.

In north-eastern Africa, the people are a mixture of Black Africans and people of Arabian descent. As in North Africa, Islam is the chief religion. But an ancient Christian civilization has survived among the Amhara people of Ethiopia for about 1,500 years.

Madagascar

Africa has many offshore islands, including Pemba and Zanzibar, off the coast of Tanzania. But the largest African island by far is Madagascar. With an area of 587,041 square kilometres (226,658 square miles), it is the fourth largest island in the world. The original people of Madagascar came from Indonesia about 1,000 years ago. The chief language, Malagasy, is of Indonesian origin. Later immigrants to the island included Bantu-speaking Africans and Arabs.



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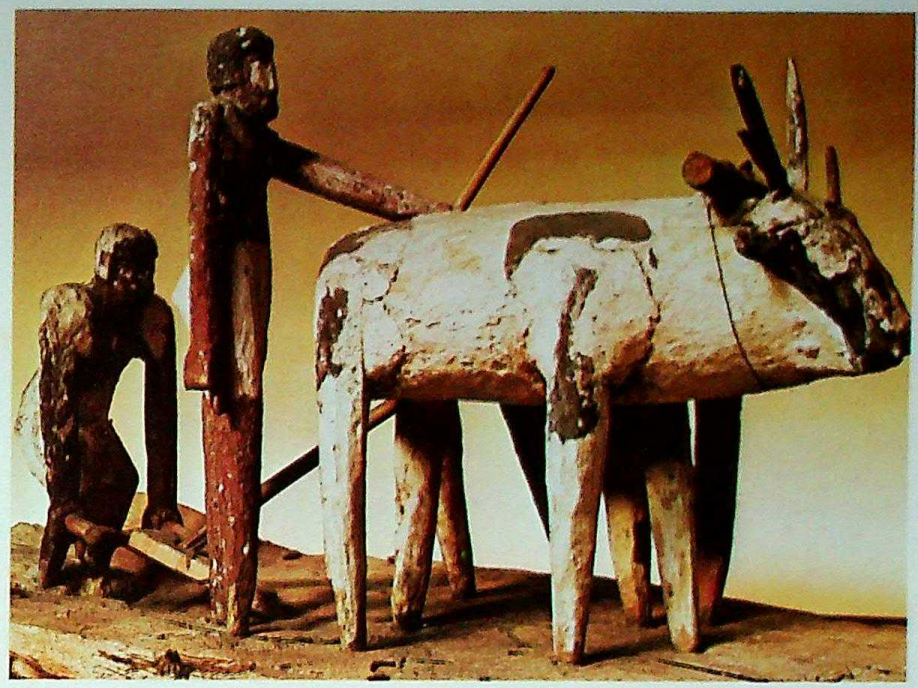
EARLY AFRICA

Most of Africa consists of high tablelands, or *plateaux*. The plateaux are generally higher south of the equator than they are to the north. The high plateaux are mostly rolling plains. In places, however, great volcanic mountains tower above the surrounding land.

Many scholars believe that the early development of Man occurred on the African plateaux. Many bones and skulls of ape-like men and man-like apes have been found in the rocks, especially in Tanzania and Kenya. The presence of nearby stone tools shows that these remains are of man-like creatures.

Near the coasts the plateaux fall steeply away to very narrow coastal plains. Rivers flowing down the steep slopes are interrupted by deep waterfalls and treacherous rapids. These obstacles made it difficult for people to travel by boat into the interior of Africa. Travel overland was also difficult because of the hot deserts, swamps, and thick, tropical forests. As a result Europeans knew little of the interior until the 1800s. They called Africa the 'Dark Continent'.



This wooden model of a ploughing scene was found in a 4,000-year-old Egyptian tomb. It reflects the advanced state of agriculture of the time.

Ancient Egypt

Ancient Egypt was Africa's first great civilization. It grew up in the Nile valley. Before about 3000 BC the Sahara desert had been a grassy region, with far more rain than it has today. But then it became drier, and its people moved outwards. Some became farmers in the Nile valley, where there was plenty of water. The soil was fertile as a result of the annual flooding of the river.

As their civilization grew, the ancient Egyptians developed a complex society, and became skilled in the arts, science and technology. They built great stone pyramids and temples which stand today. At first, the ancient Egyptian civilization had little influence on Africa south of the Sahara. It did later, however, at a time when iron was being used for tool-making. Slowly the use of iron spread southwards to people who had hitherto only used stone tools. They passed directly from a Stone Age to an Iron Age.

Across the Deserts

When the power of Ancient Egypt began to wane, in the 100s BC, the Romans conquered North Africa. They introduced the camel from Arabia. Later the people used camels to carry them across the deserts. In the Middle Ages, Europeans regarded the Sahara as a barrier to travel. But Arabs and Berbers crossed the desert regularly in camel caravans. And our knowledge of the empires of West Africa at the time, such as the ancient Ghana and Mali empires, is based on the descriptions of Arab and Berber traders and scholars. Arabs from Arabia also sailed down the coast of East Africa. By AD 1100 they were trading as far south as Mozambique and Madagascar.

Little is known of the early history of the Bantu-speaking peoples in the interior of central and southern Africa. Recent research has suggested that they came originally from west-central Africa, north of the tropical forests. By 300 BC they had settled in the Lake Victoria region, and by about AD 500 they were in southern Africa. They were farming people who used iron tools and iron-tipped spears. In southern Africa the Bantu-speaking peoples met the earlier inhabitants – the Bushmen and Hottentots – who could not stop the advance of the more developed Bantu.

The Slave Trade

European exploration of Africa began in the 1400s, when Portuguese sailors mapped the Atlantic coast. In 1498 the Portuguese explorer Vasco Da Gama sailed around Africa to India. The Portuguese began to trade along the coasts of Africa, and started to ship slaves to Europe. Soon the British, Dutch and French joined the Portuguese in the slave trade. They shipped slaves to work on cotton plantations in the Americas. No-one knows how many slaves were taken between 1550 and 1850, but it was probably over 15 million. The European traders bought slaves from coastal Afri-

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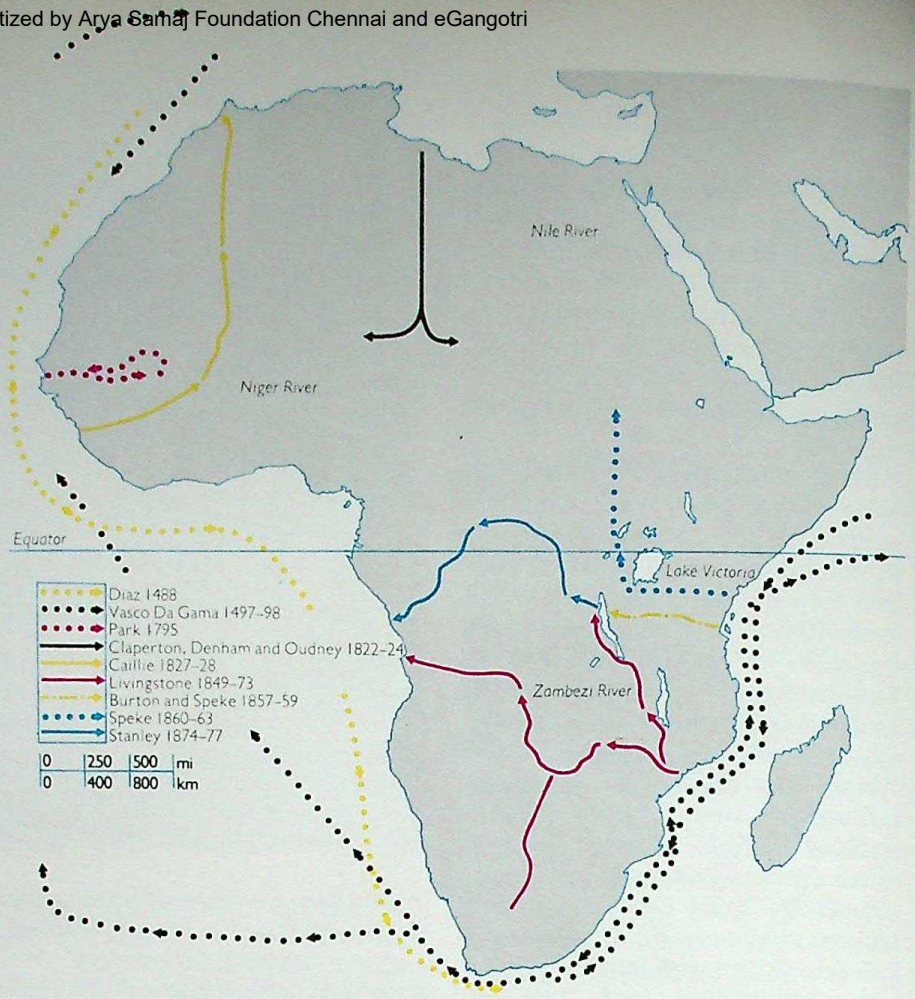
can chiefs, who obtained them by raiding inland villages. The traders seldom travelled inland.

The first European settlement in southern Africa was founded by the Dutch at Cape Town in 1652. It supplied water and fresh food to Dutch ships sailing between Europe and Asia. But as the settlement grew, some Dutch families moved inland. There they met the Bantu-speaking peoples who were moving south. This led in 1779 to wars which lasted for nearly 100 years.

Exploring the Interior

European exploration of Africa's interior began in the 1700s. It was inspired partly by Christian missionaries, partly by people who wanted to stop the slave trade, and partly by scholars interested in geography. The early explorers suffered great hardships. One of the first was a Scotsman, Mungo Park, who explored the Niger River in West Africa in the 1790s. On a later trip in 1805, he was drowned in rapids in the river. In 1827–1828 a Frenchman, René Caillié, became the first European to visit Timbuktu in Mali. In the 1850s, the German Heinrich Barth explored the Sahara.

In the 1840s, two German missionaries became the first Europeans to see the snow-capped Mt Kilimanjaro and Mt Kenya in East Africa. But the greatest explorer of all was a Scottish missionary doctor, David Livingstone. Between 1841 and 1873 he explored southern and central Africa, including the Zambezi River, Lake Nyasa (Malawi), and Lake Tanganyika. He died in the interior in 1873. His loyal African bearers cut out his heart and buried it under a tree. They then carried his body to the coast. From there it was shipped to England and buried in Westminster Abbey. In 1858, John Hanning Speke, a British soldier, was the first European to see Lake Victoria, one of the sources of the Nile. Between 1874 and 1877 the journalist Henry Morton Stanley crossed Africa from east to west, and explored the Zaire (Congo) River basin. But he is probably best remembered for his words when he found Livingstone at Ujigi on an earlier expedition (1871): 'Dr Livingstone, I presume.'



This map shows routes taken by some of the early European explorers of Africa. Africa remained 'the dark continent' until well into the 1800s, when explorers like Livingstone penetrated the interior.

Colonization and Independence

Exploration increased European interest in Africa, and gradually the European nations began to divide the continent into colonies. The colonial powers were Belgium, Britain, France, Germany, Italy, Portugal and Spain. By 1902 the only independent African countries were Ethiopia and Liberia. Liberia had been founded in the 1820s by the United States as a home for freed slaves. South Africa became independent of Britain in 1910. This followed the second Boer War, fought between Britain and the Dutch settlers from 1899 to 1902.

After World War I (1914–1918) Germany lost its possessions in Africa. In 1922 Egypt gained independence from Britain. After World War II more countries began to demand independence. The European powers resisted most of the African demands at first, but gradually gave in.

By 1960 ten African nations were independent – Liberia, Ethiopia, South Africa, Egypt, Libya, Tunisia, Morocco, Sudan, Ghana and Guinea. In the 1960s and 1970s the map of Africa changed quickly. By the end of 1975, 47 out of the 55 African nations were fully independent. In addition, the white government of a British colony, Rhodesia, had declared itself independent in 1965. But Britain and most other countries of the world considered this action illegal. They believed that Rhodesia should become independent only when the black Africans, who make up most of the population, controlled the government.

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THE CLIMATE

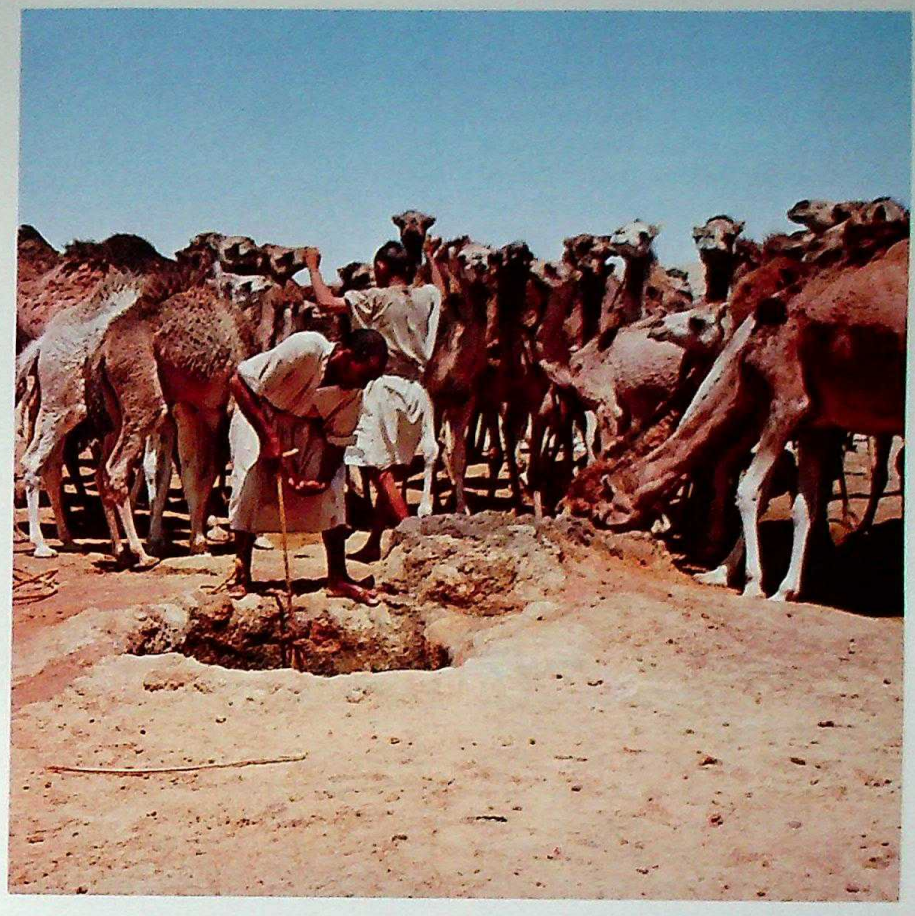
The Climate

Africa is the only continent which extends about the same distance north and south of the equator. As a result, the climates of the north follow a similar pattern to those of the south. Most of Africa lies in the tropics. But north-western Africa and the far south-west are outside the tropics and have a Mediterranean-type climate.

The tropics are the warmest zone on Earth. Around the equator, the temperature is high all the year round. At sea level the average daytime temperature is about 27°C (80°F). It changes little during the year, but there is a great difference between day and night. At night, the temperature often falls by about 11°C (20°F). The high plateaux and mountains in the tropics have lower temperatures, because the temperature drops increasingly as you go higher. The temperature falls by about 6°C for every 1,000 metres (3½°F for 1,000 feet) increase in altitude. Africa's highest mountains, Mt Kilimanjaro and Mt Kenya, are so high that temperatures are below freezing at their peaks. They are always capped by snow, even though they are close to the equator.

Away from the equator, there is a greater difference between daytime and night-time temperatures and between temperatures at different times of the year. In the Sahara desert afternoon temperatures in summer may reach more than 54°C (130°F). In winter the daytime temperature may reach only 27°C (80°F), and the nights may be frosty. The Mediterranean regions have warm summers and cool winters. Temperatures do not vary so much between day and night. The presence of the oceans moderates the changes in temperature.

Rainfall varies greatly over the continent. Along the equatorial coasts of west-central Africa and in the Zaire River basin, rainfall is heavy throughout the year. The coastal regions have about 3,810 mm (150 inches) of rain every year. The Zaire basin has more than 2,032 mm (80 inches). In contrast parts of the Sahara and Namib deserts have less than 25 mm (one inch) of rain a year. Between the hot, wet equatorial regions and the dry deserts are areas where the rainfall varies according to the season. Some areas have two rainy seasons and others have one. In most areas the majority of the rain falls in summer. In Mediterranean areas, however, most rain falls in winter.



Great tracts of Africa are barren desert. Water is found only rarely at oases, such as this one in Tunisia (above). In contrast, other areas, such as Zaire (below), are covered by dense tropical rainforest, with abundant water.

Natural Regions

Africa can be divided into four main climatic regions which have contrasting vegetation: (1) Mediterranean regions, which are areas with winter rainfall; (2) Deserts, which are areas with very little rainfall; (3) Savanna and Grassland regions, which are areas with summer rain and dry winters, and (4) Forest regions, which are areas with rain throughout the year.

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THE MEDITERRANEAN REGIONS

The Mediterranean regions of Africa have a climate and plant life similar to those of southern Europe. The largest Mediterranean region is in north-west Africa. It includes the slopes of the Atlas mountains and the coastal areas of Morocco, Algeria and Tunisia. Another smaller area lies on the north-east coast of Libya. Along the rest of the North African coast the Sahara extends to the sea.

In Mediterranean lands the plants are adapted to survive the hot, dry summer. Many of them are thorny, and have spiny or waxy leaves to reduce water loss. Cedar and cork oak grow on the wetter slopes of the Atlas mountains, but most of the original forest has been cut down. The chief type of vegetation is *maquis*. This consists of shrubs and small trees, such as myrtle and olive, which can withstand drought. Olives are one of the chief crops in north-west Africa. Their oil is used in salad dressing and cooking, and in soap-making.

Farming is highly developed in north-west Africa, and many parts of the lowlands are irrigated. Among the many crops grown there are barley, wheat and other cereals; tobacco, and such fruits as apricots, dates, figs, oranges and grapes. Sheep and goats are kept in more rugged areas. Goats are destructive animals. They nibble the grass to its roots, rip shrubs and young shoots of trees out of the ground, and tear bark off the trees. In many places goats have stripped the land bare. Wind and rain have then eroded or worn away the soil, leaving barren hillsides.

The largest of the Mediterranean-type regions in Africa is located in the extreme north west. The above picture shows part of this region, in Morocco. With irrigation, much of the land can be farmed. The picture below shows part of the Mediterranean region of eastern Libya.

The smaller Mediterranean region of Cape Province was the first place in South Africa to be settled by Europeans. It is a little closer to the equator than north-west Africa; it has warmer winters, and the summer drought is less severe. Maquis is the natural vegetation, but goats and sheep have thinned it out. Patches of forest, including cedars and cypresses, grow in sheltered areas. These patches increase towards Port Elizabeth in the east, and the summer drought is less and less marked. The valleys are fertile. They support vineyards and fruit orchards, producing apricots, figs, grapefruit, oranges, peaches, pears and plums. The chief cereal is wheat.

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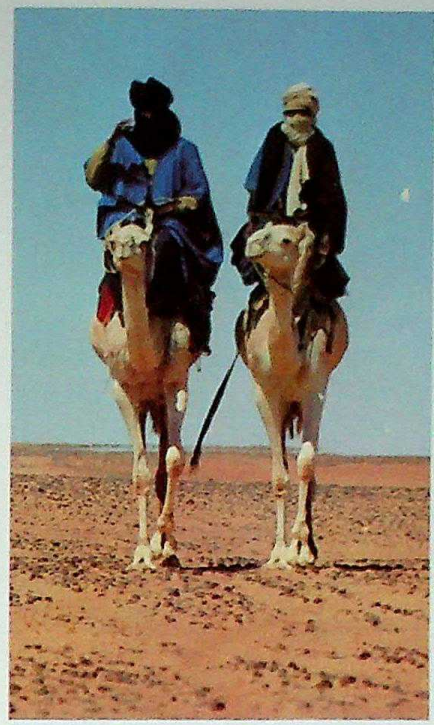
THE DESERTS

Hot deserts are among the most unpleasant places on Earth and so few people live in them. Two-fifths of Africa are covered by hot deserts, including the world's largest desert, the Sahara. This has an area of about 8,000,000 square kilometres (3,000,000 square miles) and is nearly as large as the United States. The Sahara stretches more than 5,000 km (3,000 miles) from the Atlantic Ocean in the west to the Red Sea in the east. From north to south, it is between 1,300 and 1,600 km (800–1,000 miles) wide.

The name Sahara comes from an Arabic word, *sahra*, which means *wilderness*. Sand dunes, called *erg* in Arabic, cover about one-third of the Sahara. Strong winds constantly blow the sand about, changing the shapes of the dunes. They often lift up dust to form dust storms. But most of the Sahara has little or no sand. Some areas, called *hammada*, are bare, rocky plains. Others, called *reg*, are strewn with small stones.

Rainfall in the Sahara is very scanty. Most parts receive an average annual rainfall of less than 25 mm (1 inch). But the mountain regions of Ahaggar, Aïr and Tibesti have between 125 and 250 mm (5–10 inches) annual rainfall. The rainfall is irregular, and usually occurs in short, violent storms. Years may pass between one storm and another.

The Sahara is very hot indeed. The world's highest air temperature in the shade, 58°C (136.4°F), was recorded in 1922 in the Sahara at Azizia, south of Tripoli, in Libya. Much of the Sahara has average July temperatures of more than 38°C (100°F). In the sun temperatures rise far higher, and the sand and rocks are often heated to 71°C (160°F) or more. After sunset, however, the temperature drops rapidly. In winter frosts often occur at night, although the day remains very warm. People in the Sahara wear heavy clothes to protect themselves against the cold at night and the heat of the day, and against dust storms.



Tuareg nomads, who herd camels, sheep and goats across the wastes of the Sahara Desert.

The Sahara covers much of nine African countries: Algeria, Chad, Egypt, Libya, Mali, Mauritania, Morocco, Niger and Sudan. The world's longest river, the Nile, is the only river to cross the Sahara. In Egypt about 95 out of every 100 people live in the Nile valley. Here and there in the deserts fertile *oases* occur. At oases underground water is brought to the surface and is used to irrigate the land. Date palms, fruit trees and cereals may be grown there.

Large parts of the Sahara have no plant life at all. But in many areas, if sudden storms do occur, plants spring up rapidly. They germinate, grow, flower and fruit very quickly. The seeds may then lie dormant for years starved of moisture before the next storm. The chief desert animals are burrowing creatures and insects.

The people of the Sahara include the Berbers, who are farmers, and Arabs, most of whom were once herdsmen. But the Berbers and Arabs have intermarried and most now lead a settled life. Among the herdsmen of the Sahara are the Tuaregs of the Ahaggar and Aïr mountains. The Tuaregs wind a long strip of cloth around their heads to cover their mouth and nose; only their eyes are visible. They are wandering *nomads* who herd camels, goats and sheep. The Arabs were once great traders who crossed the Sahara in camel caravans. Today cars and buses as well as caravans cross the desert on regular routes. But crossing the desert is still hazardous. Parts of the Sahara, especially in Algeria and Libya, are changing because of the discovery of rich deposits of petroleum and natural gas.

Deserts of Southern Africa

Deserts also occur in the Horn of Africa, mainly in Somalia, and in southern Africa. The one true desert of southern Africa is the Namib. It runs about 1,300 km (800 miles) along the coast of Namibia (also called South-West Africa). It extends inland between 50 and 160 km (30–100 miles). Shifting sand dunes cover large areas. The Namib is much cooler than the Sahara. For example, the port of Walvis Bay has an average temperature in the warmest month of only 19°C (66°F). Much of the Namib has hardly any rainfall at all. The average annual rainfall at Walvis Bay, for example, is only 7 mm (0.3 inches).

Inland in southern Africa lies the Kalahari desert. This covers about 500,000 square kilometres (200,000 square miles), mainly in Botswana and eastern Namibia. But the Kalahari is not a true desert. In the south the annual rainfall is about 127 mm (5 inches), but it increases in the north to about 508 mm (20 inches). Grasses, shrubs and low trees in the south gradually merge into open forest in the north. The Kalahari also contains several inland drainage basins, whose rivers flow into large swamps. But no surface water can be found over most of this semi-desert. The Bushmen who inhabit the Kalahari live by hunting and by gathering roots and berries.

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SAVANNAS & GRASSLANDS

A wealth of wildlife is found in the African savanna. Lions and giraffes (opposite page) are common. In the picture above lionesses move over savanna at the foot of Kilimanjaro, in Tanzania.

Between the deserts and the wet tropical forests of Africa are vast areas of a type of grassland called *savanna*. Savanna covers about two-fifths of Africa. It is not open grassland like the pampas of South America and the prairies of North America. Instead, it is broken by light woodland, clumps of trees, thorn bushes or scrub. The grass becomes green when the summer rains fall. But it turns yellow during the dry winter. The type of savanna varies according to the amount of rainfall and the height of the land.

A broad belt of *moist savanna* surrounds the tropical forests of west and central Africa. East-west it runs from Uganda to Gambia. To the south, it covers parts of southern Zaire and northern Angola. It also spreads over most of Madagascar. The moist savanna has plenty of rain in summer. Tall grasses, such as elephant grass, flourish in the moist savanna. So do scattered trees or clumps of trees, including the thick-trunked baobab and various acacias. Strips of forest often grow along rivers in the moist savanna regions.

Another kind of savanna lies to the south of the moist savanna. It is sometimes called *dry forest* or parkland. The dry forest region extends from Angola, through Zambia and Malawi, to western Tanzania. It has many small, flat-topped trees that rise above the tall grasses.

Dry savanna extends through southern Africa from Namibia (South-West Africa) to Kenya in East Africa. It also forms a broad belt from Somalia in the east to Senegal in the west. The grasses of dry savanna are low. Thorn bushes, which can resist drought, are more common than trees. As the rainfall decreases, the dry savanna merges into dry scrub and desert.

Animals of the Savanna

The savanna regions support a great variety of wildlife, including such large animals as elephant, buffalo and rhinoceros. Antelope, giraffe and zebra are typical grazing animals. Lion,

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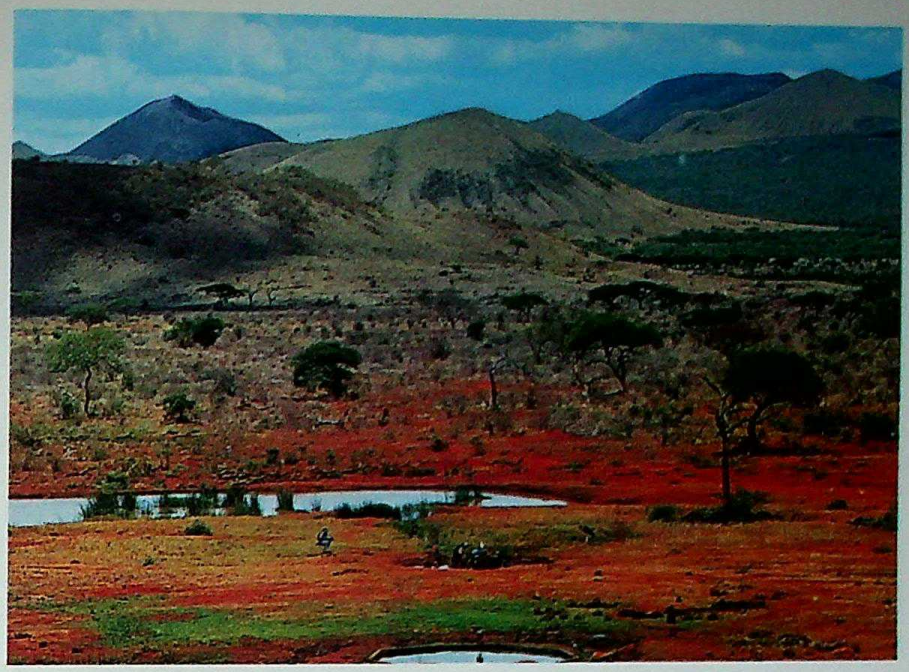
cheetah, and other predators prey on the grazing animals. Various scavengers clear up the remains of dead prey. They include hyenas, jackals and vultures.

The wildlife of savanna regions once lived in far greater numbers than they do today. Hunting and other activities of Man have greatly reduced their populations. Many wild animals are now protected in national parks, which attract many tourists from all over the world. Tourism provides a useful source of income for several African countries.

Farming the Savanna

Savanna vegetation is much easier to clear than tropical forests. And in the moist savanna regions farming is important. Such crops as cotton, groundnuts, maize and tobacco are grown there. But as the savanna becomes drier, so farming becomes more difficult.

In many parts of the savanna, the rainfall is unreliable. And sometimes the summer rains fail. Terrible droughts occur when this happens for two or three years in succession. A prolonged drought occurred in the savanna regions south of the Sahara in the early 1970s. The crops failed, water supplies dried up, cattle died of thirst, and thousands of people starved to death.



A waterhole in typical savanna country in Kenya. Wildlife for miles around go there to slake their thirst, usually at sundown.

Many people keep cattle in dry savanna regions. In some areas the herdsmen believe that their importance is measured by the number of cattle they own. They therefore breed large herds. Cattle eat mainly grass, unlike most wild browsing animals, which eat the leaves of trees and shrubs as well. They also drink more water than wild animals. This often leads to over-grazing, and over-use of the water supply. The result is soil erosion, which makes the land unfit for any animal. Some experts consider that such wild animals as wildebeest and zebra should be bred for their meat, instead of cattle. These animals are better adapted to the savanna and would provide an equally good source of food.

Highland Savanna

In South Africa large areas of savanna called *bushveld* occur at altitudes below 1,220 metres (4,000 feet). Higher up, open, temperate grasslands occur, forming the so-called *high veld*. The high veld is too cold and too exposed for trees to grow, and it is also very dry. The shortage of water limits the number of cattle which can be kept there.

A similar situation exists in Ethiopia. Below 1,500 metres (5,000 feet) is a tropical zone. The region between 1,500 and 2,750 metres (5,000–9,000 feet) contains various kinds of savanna, including some open grassland. It is called the *woina dega*, or wine highlands. Above 2,750 metres (9,000 feet) lies the *dega* (highlands), where alpine-type pastures are found. Similar zones of vegetation are to be found in the highlands and mountains of East Africa. Parts of the highland grasslands of Ethiopia and East Africa stay green and lush the whole year round.

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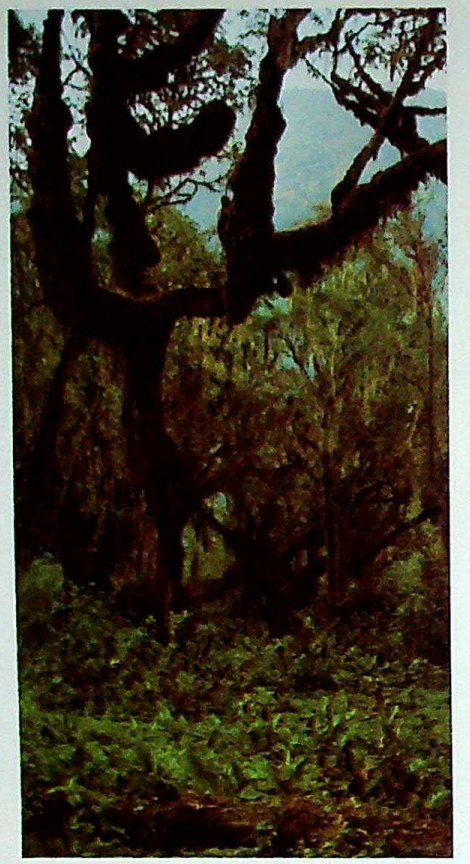
THE FORESTS

Forests cover just under one-fifth of Africa. But the forests are slowly shrinking in size as more and more land is used for farming. The largest forests are the tropical, or rain forests of the West African coastlands and the Zaire River basin. There is also a strip of tropical forest along the east coast of Madagascar.

Tropical forests have a warm and wet climate throughout the year. The rain is mainly *convectional*. Convectional rain occurs when the sun's heat causes hot, moist air to rise in convection currents during the day. The air is cooled as it rises, and the water vapour condenses into clouds. In the afternoon further condensation leads to heavy downpours.

The plants that live in tropical forests grow, flower and seed all the year round because of the heat and humidity. Typical tropical forests contain evergreen trees 30 to 40 metres (100–130 feet) tall. Some trees are as tall as 50 metres (164 feet). At low levels, the tree trunks are bare. Branches and leaves grow only near the light, around the top of the trees. They form a thick *canopy*, or covering, which stops light reaching the forest floor. As a result few plants grow at ground level. But many plants flourish higher up. Some are climbing plants, which are supported by the trees. They include woody vines called *lianas*. Other plants grow in heaps of rotting leaves and plants lodged in branches. These include ferns and orchids, which are among the most beautiful of all plants. Tropical forests are not generally difficult to walk through. Only where light can reach to ground level does the vegetation become dense and difficult to penetrate. This happens in clearings and along rivers. Travellers may sometimes find their paths blocked by fallen logs or branches. But dead wood decays rapidly in the warm, humid climate. The chief difficulty for people on foot is that the rain-soaked, muddy ground is slippery to walk on.



Thick forest covering the volcanic Virunga Mountains in northern Rwanda.

Life in Tropical Forests

Like the savannas, the tropical forests support a rich variety of wildlife. Many different brightly coloured birds, butterflies and other insects live in the canopy. Chimpanzees, gorillas and monkeys live in the trees. But they are now found mainly in fairly remote areas. Other animals include leopards, okapis (small members of the giraffe family), and a few elephants. There are many poisonous snakes, including cobras, Gaboon vipers and mambas. Hippopotami and crocodiles live in the rivers. During the day, the forests are generally quiet. Most wild animals emerge only in the evening. As elsewhere in Africa, the numbers of wild animals have been greatly reduced by Man.

Man has greatly modified the tropical forests in other ways. In fact, few patches of the original, or *virgin*, forests have survived. Most of the forest is secondary forest. This grows up after the land has been cleared and then abandoned for 90 years or more. However, in areas where lots of people live, secondary forest does not usually have chance to develop. This is because it is cleared again and again.

Farming in Tropical Forests

The chief method of farming in tropical regions is called *shifting cultivation*. The people first clear a plot of land by cutting down all the vegetation. They then grow crops on it for two or three years. By this time the soil has become infertile, and crop yields fall. The soil in tropical regions is not very fertile anyway. Most of the chemicals that make soil fertile are taken from the soil by the trees. When the soil is exposed to heavy rainstorms, the rainwater washes the remaining chemicals from the soil.

In much of Zaire, for example, farmers move from plot to plot in a haphazard way. However, in West Africa, people return to abandoned plots after a few years, when the soil has been rested. More advanced plantation agriculture is also practised in some tropical regions. Such valuable crops as oil palm and cocoa are produced. Chemical fertilizers are added to the soil to keep it fertile.

Tropical forests contain many valuable hardwood trees, including mahogany, ebony, satinwood and rosewood. In some African countries these trees are felled, and the timber is exported. The valuable trees are usually scattered throughout the forest. They are often difficult to find and are hard to remove. Usually foresters work along the rivers. Then they can transport the logs by water.

Other Forest Regions

Other kinds of forest regions in Africa include the mangrove swamps found in the river estuaries and coastal regions of East and West Africa. Mangroves are trees which drop roots from their

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branches into the swampy waters. These roots are called prop roots because they help prop up the tree. They are also able to breathe in air. Together mangrove trees form tangled thickets which are very difficult to penetrate.

The mountains of Africa also have distinctive forests. Various species thrive including evergreens and bamboo thickets. The warm temperate forests of South Africa are small, but they contain many varieties of deciduous and coniferous trees, similar to those of temperate latitudes. The Mediterranean forests of north-west Africa have been mostly cleared, but areas of cedar and cork oak still remain.

Luxuriant vegetation of the tropical rain forest in the hot and humid Zaire basin.

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MOUNTAINS & VALLEYS

Africa consists mainly of rolling plateaux, or tablelands. But high mountains and ranges rise above the general level of the plateaux in places. Africa also contains some of the world's biggest lakes and rivers. The Rift Valley in eastern Africa is the largest gash in the Earth's crust, and Madagascar is the world's fourth largest island.

The Drakensberg Mountains near Maseru, capital of the small, landlocked country of Lesotho.

Lofty Mountains

Many of Africa's mountains are formed from volcanic rocks. For example, in the Sahara the Ahaggar, Aïr, Tassili, Tibesti and Darfur mountains are all volcanic. The highest peak, Emi Koussi (3,415 metres, 11,204 feet) in the Tibesti mountains, is an extinct volcano. Other volcanic mountains occur in East Africa. They include Mt Kilimanjaro (5,895 metres, 19,340 feet), in northern Tanzania, and Mt Kenya (5,199 metres, 17,058 feet), which straddles the equator in Kenya. These two peaks are the highest in Africa.

Africa's third highest mountain, Ruwenzori (5,109 metres, 16,762 feet) is also in East Africa on the border between Uganda and Zaire. It is not volcanic but is part of a block of land which has been forced upwards by earth movements. The highest mountains of southern Africa are in the Drakensberg range. This range is capped in places by lava but is not truly volcanic. It forms the rim of the highest part of the African plateaux. Its highest point (3,482 metres, 11,425 feet) lies in Lesotho.

Glorious rolling landscape in the Transkei region, near the south-east coast of South Africa.

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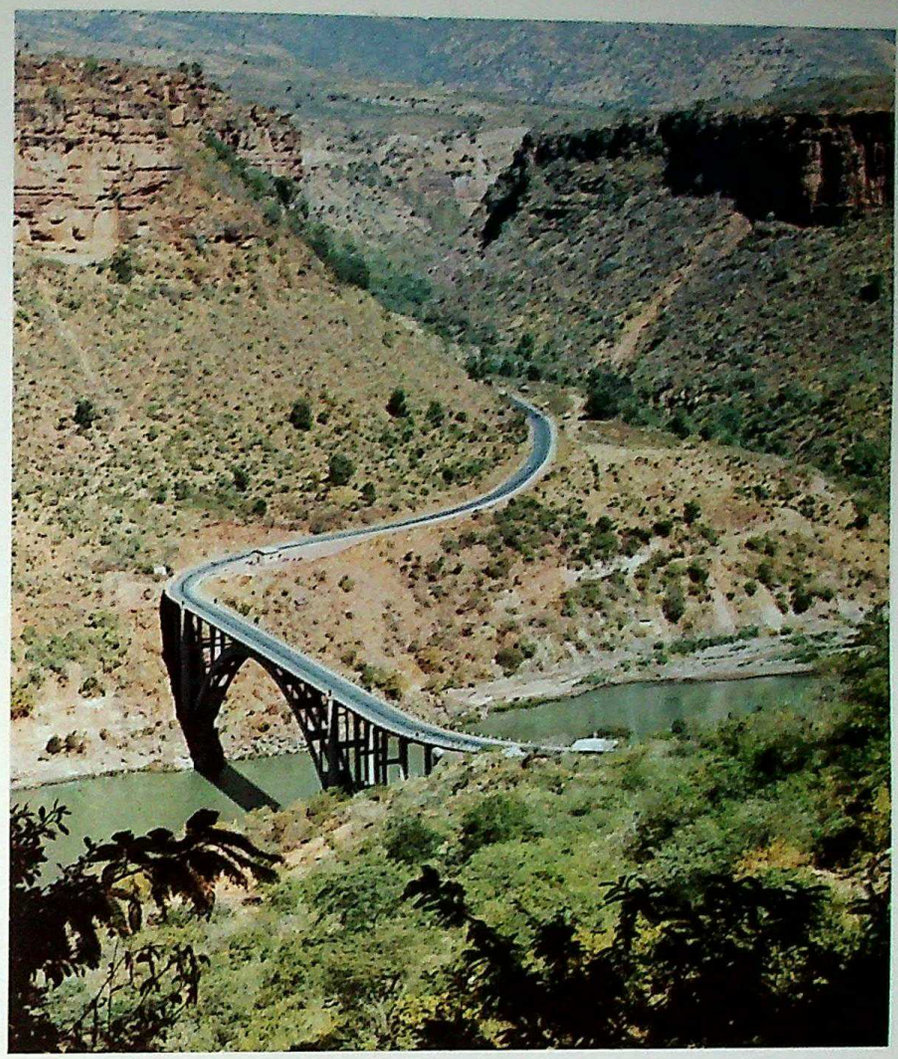
The Atlas Mountains of north-west Africa are fold mountains. They extend for about 2,400 km (1,500 miles) through Morocco, Algeria and Tunisia. The highest peak, Djebel Toubkal (4,164 metres, 13,661 feet), is in Morocco. The only other fold mountains are the Swartberg and Langeberg ranges in Cape Province, South Africa. They reach heights of nearly 2,440 metres (8,000 feet).

Great Lakes and Rivers

The African plateaux are pitted here and there by depressions, or basins. The Qattara Depression in Egypt lies 133 metres (436 feet) below sea level. It is Africa's lowest land point. Some depressions are inland drainage basins. Water flowing into these basins never reaches the sea but may form enclosed lakes or swamps. For example, Lake Chad is an inland drainage basin in north-central Africa. It covers an area of about 16,300 square kilometres (6,300 square miles), but it is gradually shrinking. Another inland drainage basin is the Okavango swamp in northern Botswana.

Lake Victoria occupies a shallow depression in the East African highlands between two arms of the Rift Valley. Lake Victoria covers 69,480 square kilometres (26,828 square miles) and is the second largest freshwater lake in the world. Other large lakes lie in the Rift Valley. They include Lake Tanganyika, which is the world's longest and second deepest freshwater lake. It is more than 640 km (400 miles) long and has an area of 32,890 square kilometres (12,700 square miles). Its greatest depth is 1,435 metres (4,708 feet). Other lakes in the Rift Valley include Lake Malawi (Nyasa), Lake Rudolf and Lake Albert. Some large African lakes, such as Lake Nasser in Egypt and Lake Kariba in Rhodesia and Zambia, are man-made.

Africa's and the world's longest river is the Nile. It is 6,695 km (4,160 miles) long. In its upper reaches it has two main branches, which unite at Khartoum in Sudan. The longer branch, the White Nile, has its beginnings in Lakes Albert, Edward and Victoria. The other branch, the Blue Nile, rises in western Ethiopia. Among other great rivers are the Zaire (4,373 km, 2,718 miles), the Niger (4,184 km, 2,600 miles) and the Zambezi (2,575 km, 1,600 miles). Most of the rivers are interrupted by waterfalls and rapids, which occur especially around the edge of the plateaux. The Victoria Falls is the largest waterfall in Africa. It lies on the Zambezi River between Zambia and Rhodesia. It has a maximum drop of 102 metres (335 feet), and passes up to 350 million litres of water a minute in the rainy season. River water is important for irrigation, especially in dry regions such as in Sudan and Egypt. Some African rivers are also important for hydro-electric power.



The Blue Nile flows through this gorge in Ethiopia on its way to meet the White Nile at Khartoum.

The Rift Valley

The Rift Valley extends from Mozambique in the south, through East Africa, Ethiopia, the Red Sea and Israel, to Syria. The valley provides some spectacular scenery. In places it is bordered by steep walls, sometimes more than 1,830 metres (6,000 feet) high. Apart from the Red Sea, the Rift Valley is about 40–50 km (25–30 miles) wide.

In parts of the Rift Valley, volcanoes occur. Volcanoes and earthquakes also occur along the centre of the Red Sea. Geologists believe that a large crack in the Earth's crust runs through the Red Sea. They call this crack a *plate edge*, because it divides the plate (section) of the Earth's crust bearing Africa, from another plate bearing Arabia. New volcanic rock is being added to the crust along the plate edge. This is slowly widening the Red Sea. Geologists estimate that the Red Sea has been widened by about 320 km (200 miles) in the last 20 million years.

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AFRICA'S ECONOMY

Africa covers more than one-fifth of the world's land area. But it produces only about one-fiftieth of the world's total goods and services. Because its production is low, most people in Africa are poor. One of the reasons for low production is that about three out of every four Africans work on farms. Most Africans are subsistence farmers. That is, they produce only enough food to feed themselves and their families. Others produce cash crops for export.

Africa has few large cities. Only five out of the top 50 cities of the world are in Africa. They are Cairo, Egypt (population 5,126,000); Alexandria, Egypt (1,900,000); Casablanca, Morocco (1,506,000); Johannesburg, South Africa (1,433,000) and Kinshasa, Zaire (1,300,000). Other cities with more than a million people include Tunis in Tunisia; Cape Town in South Africa; and Lagos and Ibadan in Nigeria. Most of Africa's large cities are in the north and south of the continent, where industry and agriculture are best developed.

Farming

In much of tropical Africa, farming methods are still very primitive. Women do most of the work. They use simple tools, such as digging sticks for making holes for seeds, hoes, knives and axes. Shifting cultivation is widely practised in tropical forest and savanna regions, and crop yields are generally low.

Although farming is Africa's chief industry, more than half of the continent is too dry for farming. In many farming areas, the rainfall is unreliable and long droughts often occur. Another problem is that many soils in Africa are not very fertile. Africa produces most of the food which the people eat. But many Africans suffer from illnesses caused by unbalanced diets. For example, in tropical Africa, the chief food crops include bananas, maize, manioc, millet and yams. These starchy foods are filling, but they lack the proteins which are vital to life. High-protein foods include meat, milk, eggs and some plants, such as groundnuts. Fish is another high-protein food. Fishing is important in areas around the great African lakes and around the coasts of Morocco, Namibia (South-West Africa) and South Africa.

Cash Crops

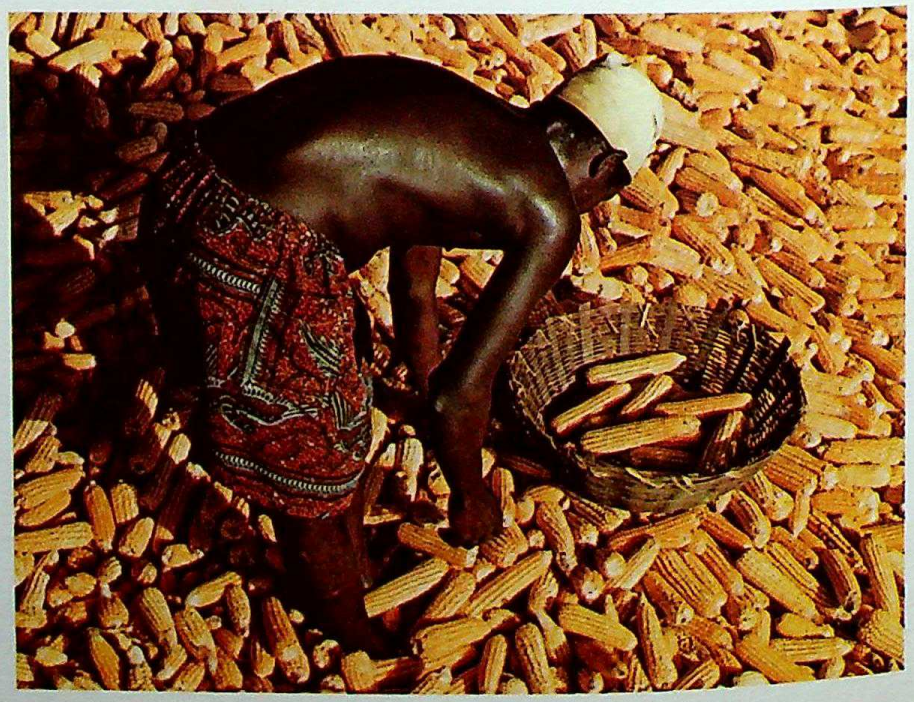
In the 1900s, the Europeans who settled in Africa introduced new methods of farming. They set up large plantations to produce cash crops such as coffee and tobacco. These crops were sold to other countries as exports. The Europeans also encouraged Africans to increase the production of such crops as cocoa beans and oil palm. Today most African countries depend for their wealth on exporting cash crops. For example, Ghana is the world's leading cocoa producer; Nigeria leads the world in oil-palm production.

Important crops in tropical forest regions include cocoa, rice, bananas and oil palm, which is used to make margarine and soap. Coffee is another tropical crop, but most coffee plantations are located in highland regions. Coffee originated in the mountainous country of Ethiopia, where it still grows wild. It is also a leading crop in Ivory Coast, Angola and the nations of East Africa (Kenya, Tanzania and Uganda).

The wetter savannas produce such crops as cotton, groundnuts (peanuts) and tobacco. The most important cotton producer is Egypt. Cotton is also grown in Sudan and parts of East and West Africa. Groundnuts are leading exports from Gambia, Mali and Senegal. Tobacco is grown in Malawi, Rhodesia, South Africa and Zambia. The main food crop in savanna regions is maize.

The Mediterranean areas of North and South Africa produce olives, fruits, vines, barley and wheat. There are many kinds of Mediterranean fruits, many of which are tinned and exported. Vines are grown and grapes, raisins and wine are important products. Barley and especially wheat are the chief food crops.

Timber is an important export in many parts of the continent. Tropical forests contain valuable hardwoods, but they are difficult to exploit. South Africa has only a small area of forest but forestry is well-developed and timber is



Maize is grown on a large scale in Africa. Here a Ghanaian farmer is sorting cobs.

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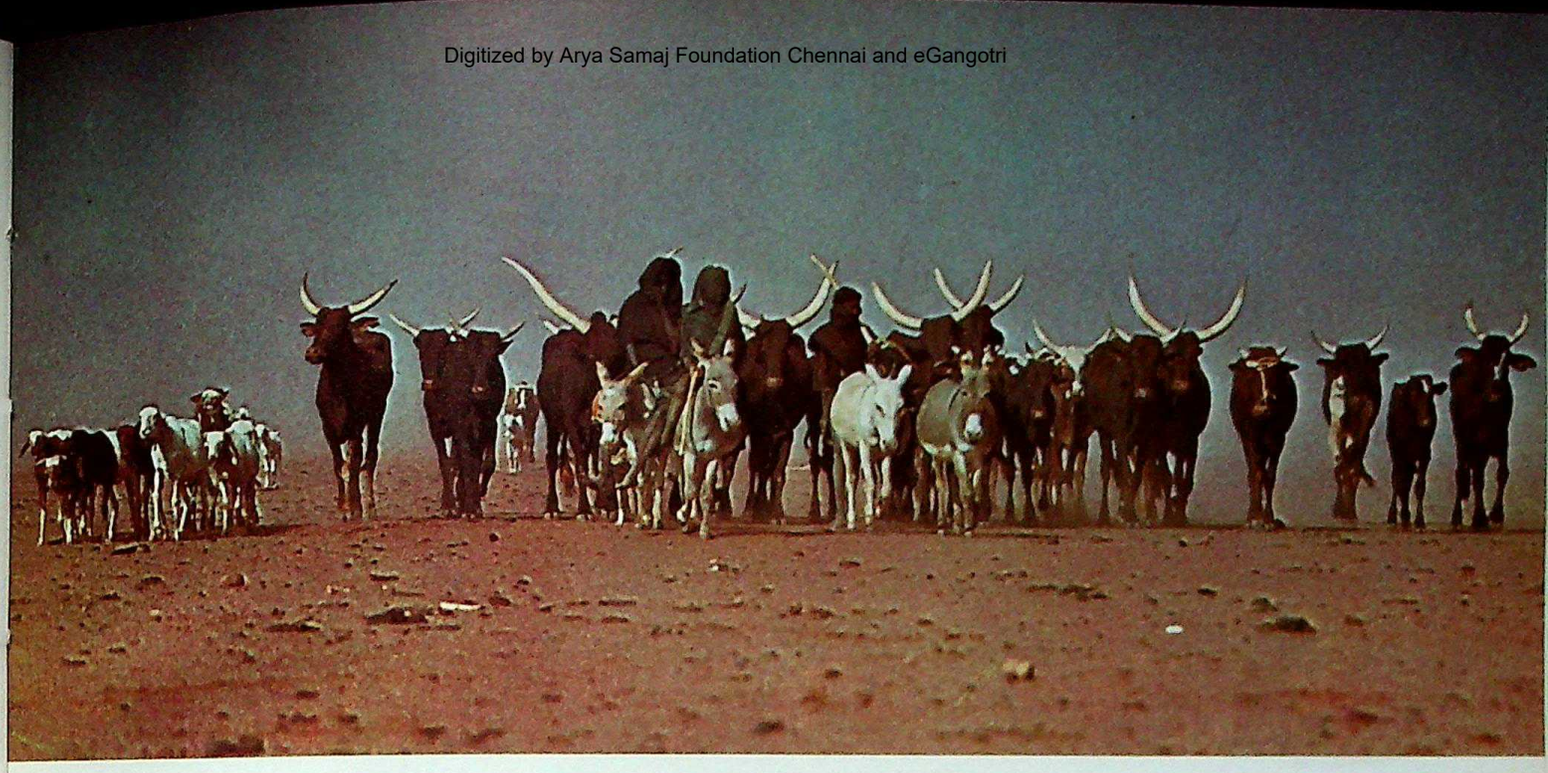

Nomads herding cattle in Niger, in West Africa. The large-horn cattle are of the Ankole breed.

an important export. One of the most important timber trees is the cork oak. The bark of this tree is used to make cork.

Livestock Farming

Livestock farming is particularly important in savanna and Mediterranean regions. In savanna areas, the African cattle are mostly of poor quality. Overlarge herds quickly consume the pasture and then all the cattle starve. Pests and diseases limit livestock farming in many areas. In much of central Africa, the tsetse fly spreads a disease which kills cattle in a few weeks. Tsetse flies sometimes carry a deadly human illness called sleeping sickness. African cattle also suffer greatly from blood-sucking ticks.

In Mediterranean areas, the higher-quality cattle are often crosses between local cattle and imported European breeds. Sheep are important in drier regions, such as the Atlas Mountains, Sudan and parts of East Africa. South Africa also has large numbers of sheep. Goats are kept mainly in Mediterranean regions.

Mineral Resources

Mining is Africa's most important industry after farming. Only a few people in Africa work in mines, but the value of the minerals extracted is high. Most minerals are exported. The money obtained for these exports is vital to the economy of several African nations, including Algeria, Libya, Nigeria, Namibia (South-West Africa), South Africa, Zaire and Zambia.

Africa's eight leading exports in 1974 included four mineral items. In order of value the chief exports were petroleum, copper, cotton, coffee, cocoa, iron ore, timber and phosphates. The rapid increase in the price of petroleum in the 1970s has greatly improved the economy of Nigeria and Libya, Africa's two major petroleum producers. Algeria, Gabon, Congo, Angola, Tunisia and Egypt also produce some petroleum. The total African production amounts to about one-tenth of the world's total output.

One of the richest copper mining regions lies in southern Africa. Zambia and Zaire are the leading copper-exporting countries. South Africa, Namibia and Uganda also produce copper. The main iron-ore producing countries are Liberia, Mauritania and South Africa. Phosphates, which

South Africa leads the world in diamond production. Here a miner drills into the gem-bearing rock.

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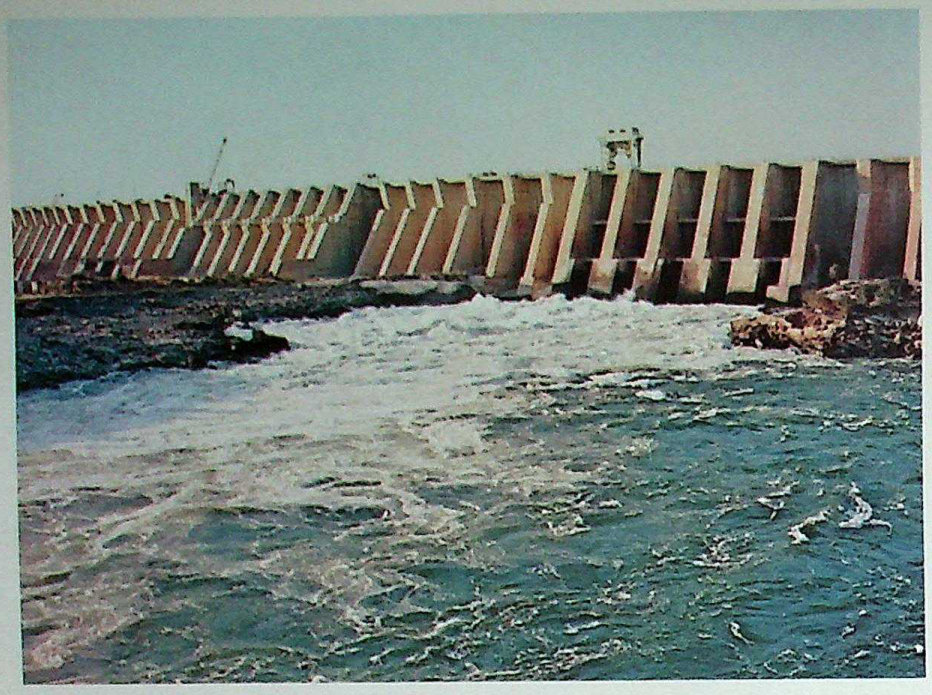

The Roseires dam, on the Blue Nile in Sudan. Dams store water for irrigation and for generating electrical power.

also increased in price in 1975, are mined in several countries. Morocco is the most important.

Africa has large reserves of many other minerals. The continent leads the world in gold and diamond production. South Africa produces more than half of the world's new gold output. The world's leading gold field is at Witwatersrand, in Transvaal province, South Africa. South Africa is also the world's leading producer of gem-quality diamonds. Zaire leads in mining industrial diamonds, which are used in cutting tools. Other valuable minerals produced in Africa are uranium ores (South Africa and Zaire); bauxite (Guinea); chromium (South Africa and Rhodesia); cobalt (Zaire); and manganese (Ghana).

Power Production

Apart from South Africa and Rhodesia, the continent is generally lacking in coal. Only in South Africa is most electrical power produced by coal-fired power stations. The rest of Africa relies mainly on hydroelectric power. Massive dams have been built across rivers to create huge storage reservoirs. The stored water is run through water turbines, which turn the electricity generators. Africa's first major hydroelectric dam, the Kariba Dam, was built across the Zambezi River in the 1950s. It supplies electricity to Rhodesia and Zambia. Egypt has the Aswan High Dam. Ghana's power comes from the Volta River hydroelectric project. At Inga, near Matadi in Zaire, a massive hydroelectric project is under construction. The first stage of this project was completed in 1972. It will be the largest hydroelectric project in the world when it is finally finished.

Manufacturing

Only a few African nations have important manufacturing industries. South Africa is by far the most important manufacturing nation. It is the most developed and richest of all African countries. Egypt is the second most important manufacturing nation. Other countries with manufacturing industries include Algeria, Kenya, Libya, Morocco, Nigeria, Rhodesia, Zaire and Zambia.

An increase in manufacturing would help Africa to raise the standards of living of the people. But the cost of setting up manufacturing industries is high. African countries can raise money by increasing their own production. But the prices they get for their exports change. For example, in 1975, six of Africa's leading eight exports fell in price. As a result, African countries got less money for them. But at the same time, they had to pay more for most imported goods, because world prices had increased. This caused a decline in the wealth of several countries.

Africa Today

Africa faces many other problems that are hindering its development. Many Africans cannot read or write. Also, the population of Africa is increasing quickly. In the 1970s, it was increasing by about 28 people per 1,000 per year (2.8%). If this continues, Africa's population will double in less than 30 years. Any increase in wealth must therefore be spread among the extra people.

Political problems also affect Africa. Most African countries have been independent for less than 20 years. In many of these nations, the people are divided into many groups. For example, the people of Nigeria are divided into about 250 groups, each with its own language or dialect. As a result, governments find it difficult to unite the people. Many countries have become one-party states, and several have military governments.

The large number of people of European origin create special problems in South Africa. Out of every 100 people in South Africa, 17 are Whites, 71 are black Africans, and the other 12 are either Asians or Coloureds. The Whites control the government, and practise a policy of *apartheid*. This word means 'apartness', or segregation. Apartheid is designed to give a separate development and way of life for Whites and non-Whites. Most non-Whites believe that this is wrong. The danger is that black Africa will one day take up arms against not only South Africa, but other White communities as well, including Rhodesia.

Despite all its problems, however, Africa has many untapped resources. With help from richer nations, the new African nations will be able to use these resources to increase their wealth and establish a sound economy.

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NORTH AMERICA

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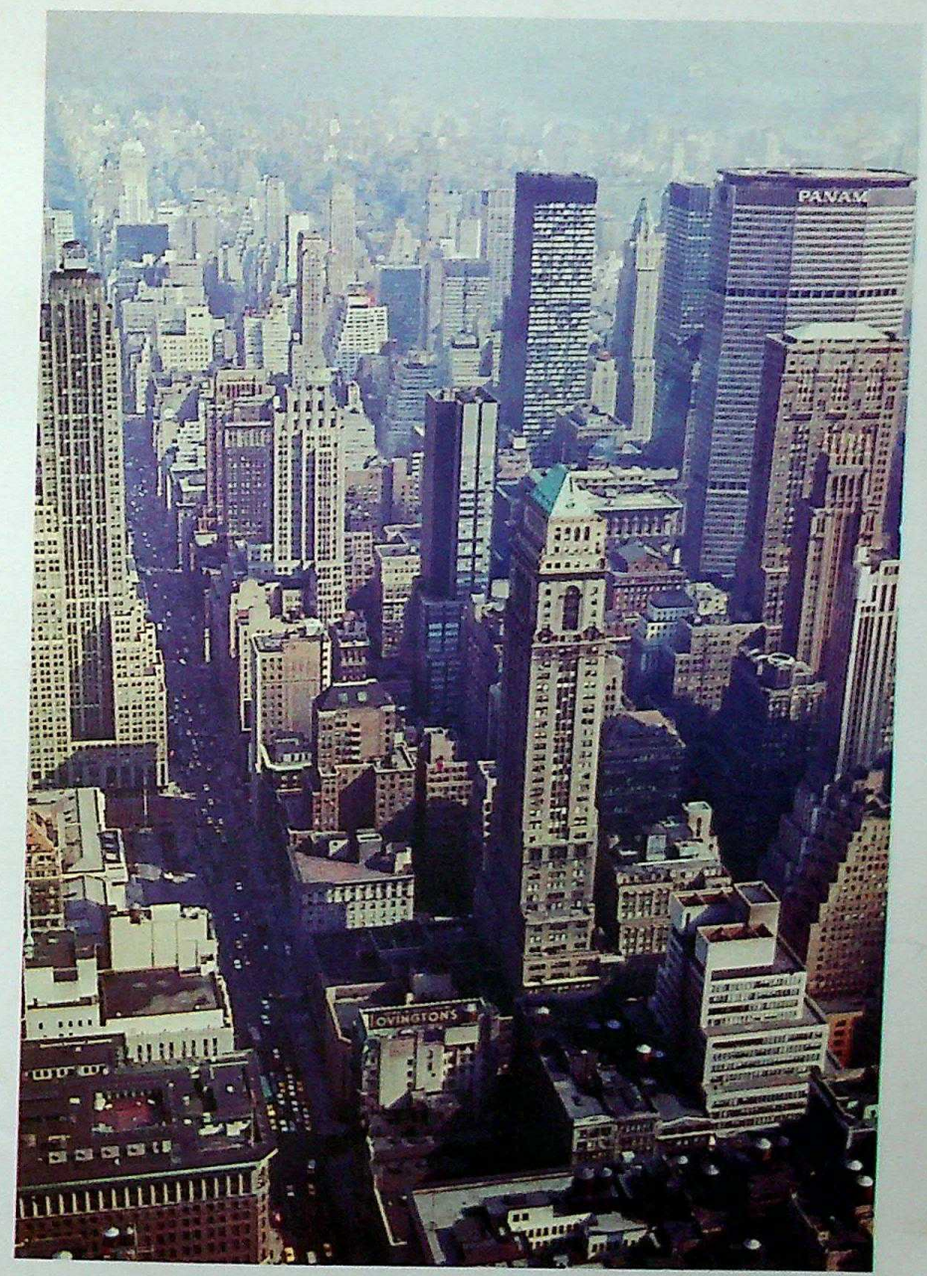
INTRODUCTION

North America is bounded in the north by the icy Arctic Ocean. West to east it extends from Alaska, through Canada, to Greenland. In the west the 90-km (56-mile) wide Bering Strait separates Alaska from Asian Russia. In the east the 350-km (215-mile) wide Denmark Strait separates Greenland from Iceland, in Europe. Southwards, North America extends from Canada, through the United States, one of the world's two great superpowers, and through Mexico into tropical Central America. North America's border with South America is Panama's frontier with Colombia. The island of Bermuda and the West Indian islands in the Caribbean Sea are also considered part of the North American continent. Increasingly Central America (Mexico to Panama) is called Middle America.

North America is the third largest continent. It covers some 24,248,400 square kilometres (9,362,400 square miles) and has a total population of about 340 million. Two large countries, Canada and the United States, occupy most of North America. The United States is slightly smaller than Canada, but has



Skyscrapers abound in New York City. For 29 years the Empire State Building was the tallest, until it was surpassed in 1970 by the World Trade Center, which is 412 m high.

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more than 6 out of every 10 of North America's total population.

The United States of America, or the US, is made up of 50 states. Forty-eight of these make up the main region of the United States. The forty-ninth state, Alaska, is separated from the others by Canada. The fiftieth state is Hawaii, which is located in the Pacific Ocean, about 3,850 km (2,400 miles) west of the Californian coast. Alaska and Hawaii are recent additions to the Union. Both became states in 1959.

Alaska, Texas, California and Montana are the biggest states by area. By population the biggest are California, New York, Pennsylvania, Texas and Illinois. Rhode Island and Delaware are by far the smallest states in area. Rhode Island has an area of only 3,144 square kilometres (1,214 square miles). This is less than one five-hundredth of Alaska's area. The capital of the United States is Washington, D.C. It is located in the District of Colombia (D.C.), an area which is administered by the US Congress. It lies on the Maryland–Virginia state boundary near the east coast.

Canada is divided into ten provinces, which are rather like the American states. In addition it has two territories. There is the vast North-West Territory and the Yukon, which are mainly icy wastelands where scarcely anyone lives. Quebec is the largest province by area, followed by Ontario. Ontario, which contains Canada's capital Ottawa, has a larger population, however.

North America has 21 cities with a metropolitan area population (with suburbs) of more than 1,500,000. Of these, 16 are in the United States. The top five US cities are New York City (11,529,000), in New York State; Los Angeles (7,032,000), in California; Chicago (6,979,000), in Illinois; Philadelphia (4,818,000), in Pennsylvania; and Detroit (4,200,000), in Michigan. On average more than 70 out of every 100 people in the US live in or near cities.

The five largest cities outside the US are Mexico City (Ciudad de México, 10,000,000) and Guadalajara (2,000,000) in Mexico; Montreal (2,743,000) and Toronto (2,628,000) in Canada; and Havana (La Habana, 1,753,000) in Cuba.

Languages and Religions

The US and Canada are mainly English-speaking countries. Quebec province in Canada is an exception, for French is the preferred language. Mexico and the Central American countries are

NORTH AMERICA:

Country	Area Sq. Km.	Population	Capital
Antigua	442	77,000	St John's
Bahamas	13,935	210,000	Nassau
Barbados	431	247,000	Bridgetown
Belize	22,965	141,000	Belize City
Bermuda	53	58,000	Hamilton
Canada	9,975,801	22,659,000	Ottawa
Cayman Is	259	11,000	Georgetown
Costa Rica	50,700	1,974,000	San José
Cuba	114,524	9,222,000	Havana
Dominica	751	74,000	Roseau
Dominican Republic	48,734	4,702,000	Santo Domingo
El Salvador	21,040	4,099,000	San Salvador
Greenland	2,175,600	54,000	Godthaab
Grenada	344	95,000	St George's
Guadeloupe	1,779	352,000	Basse-Terre
Guatemala	108,889	5,855,000	Guatemala
Haiti	27,750	4,583,000	Port-au-Prince
Honduras	112,088	2,980,000	Tegucigalpa
Jamaica	10,962	2,052,000	Kingston
Martinique	1,102	346,000	Fort-de-France
Mexico	1,972,547	58,170,000	Mexico City
Montserrat	98	12,000	Plymouth
Netherlands Antilles	961	242,000	Willemstad
Nicaragua	130,000	2,146,000	Managua
Panama	75,650	1,669,000	Panamá
Panama Canal Zone	1,432	44,000	Balboa Heights
Puerto Rico	8,897	3,119,000	San Juan
St Kitts-Nevis-Anguilla	357	66,000	Basseterre
St Lucia	616	112,000	Castries
St Pierre & Miquelon	242	6,000	St Pierre
St Vincent	388	92,000	Kingstown
Trinidad & Tobago	5,128	1,090,000	Port-of-Spain
Turks & Caicos Is	430	6,000	Grand Turk
United States*	9,363,032	214,208,000	Washington D.C.
Virgin Is (British)	153	14,000	Road Town
Virgin Is (U.S.)	344	66,000	Charlotte Amalie

*including Hawaii.

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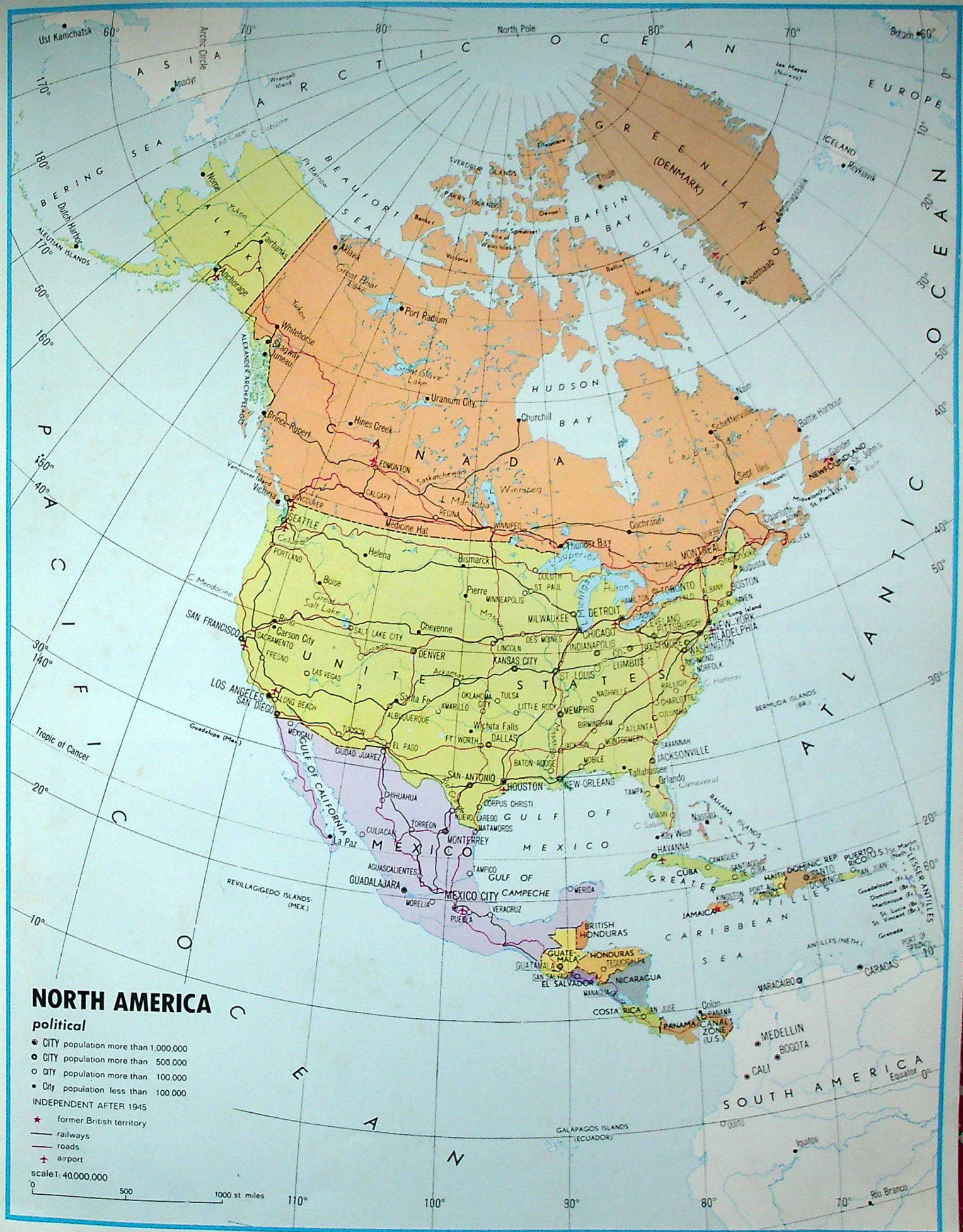
NORTH AMERICA
political
CITY population more than 1,000,000
CITY population more than 500,000
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City population less than 100,000
INDEPENDENT AFTER 1945
former British territory
railways
roads
airport
scale 1: 40,000,000
0
500
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ARCTIC OCEAN
PACIFIC OCEAN
ATLANTIC OCEAN
CANADA
UNITED STATES
MEXICO
GREENLAND (DENMARK)
SOUTH AMERICA
HUDSON BAY
BAFFIN BAY
DAVIS STRAIT
BEAUFORT SEA
BERING SEA
GULF OF MEXICO
CARIBBEAN SEA
GREATER ANTILLES
LESSER ANTILLES
ALASKA
ICELAND
EUROPE
North Pole
Tropic of Cancer
Equator
Ust Kamchatsk
Anadyr
Nome
Fairbanks
Anchorage
Aleutian Islands
Dutch Harbor
Whitehorse
Juneau
Prince Rupert
Vancouver
Victoria
Seattle
Portland
San Francisco
Los Angeles
San Diego
Tijuana
Mexicali
Ciudad Juarez
Chihuahua
Monterrey
Guadalajara
Mexico City
Veracruz
Puebla
Merida
Campeche
La Paz
Culiacan
Torreon
Nuevo Laredo
Matamoros
Corpus Christi
San Antonio
Houston
Dallas
Fort Worth
Wichita Falls
Amarillo
Oklahoma City
Tulsa
Little Rock
Memphis
Nashville
Atlanta
Birmingham
Montgomery
Jackson
Mobile
New Orleans
Baton Rouge
Jacksonville
Tallahassee
Orlando
Tampa
Miami
Key West
Havana
Cuba
Jamaica
Haiti
Dominican Rep.
Puerto Rico
Kingston
Port-au-Prince
Santo Domingo
San Juan
Guadeloupe (Fr.)
Dominica (Br.)
Martinique (Fr.)
St. Lucia (Br.)
St. Vincent (Br.)
Grenada
Antilles (Neth.)
Port of Spain
Caracas
Maracaibo
Medellin
Bogota
Cali
Panama
Panama Canal Zone (U.S.)
Colon
Costa Rica
San Jose
Nicaragua
Managua
Honduras
Tegucigalpa
Guatemala
Guatemala City
El Salvador
San Salvador
British Honduras
Belize
Yucatan
Campeche
Tampico
Aguascalientes
Revillagigedo Islands (Mex.)
Galapagos Islands (Ecuador)
Iquitos
Rio Branco
Bermuda Islands (Br.)
Hatteras
Norfolk
Richmond
Washington
Baltimore
Philadelphia
New York
Long Island
Boston
Albany
Buffalo
Toronto
Hamilton
London
Cleveland
Pittsburgh
Detroit
Chicago
Milwaukee
Minneapolis
St. Paul
Duluth
Pierre
Bismarck
Heleha
Boise
Great Salt Lake
Salt Lake City
Reno
Carson City
Sacramento
Fresno
Las Vegas
Cheyenne
Denver
Lincoln
Des Moines
Indianapolis
Columbus
St. Louis
Kansas City
Arkansas
Missouri
Mississippi
Michigan
Huron
Superior
Thunder Bay
Winnipeg
Regina
Calgary
Edmonton
Saskatchewan
Medicine Hat
Vancouver Island
Victoria
Prince Rupert
Hines Creek
Uranium City
Great Slave Lake
Great Bear Lake
Yukon
Mackenzie
Aklavik
Port Radium
Churchill
Baffin Island
Devon
Ellesmere
Sverdrup Islands
Parry Islands
Banks I.
Victoria I.
Prince of Wales Islands
Somerset
Thule
Godthaab
Ammassalik
Reykjavik
Jan Mayen (Norway)
Scoresbysund
Angmagssalik
Labrador
Goose Bay
Battle Harbour
Schefferville
Seal Nes
Gander
Newfoundland
St. John's
Charlottetown
Moncton
Saint John
Halifax
Montreal
Ottawa
Quebec
Cochrane
Kenora
Alexander Archipelago
Bahama Islands
Key West
Nassau
Cape Canaveral
Cape Sable
Cape Hatteras
Gulf of California
Baja California
Sierra Madre Occidental
Sierra Madre Oriental
Rio Grande
Colorado
Arkansas
Missouri
Mississippi
Ohio
Tennessee
Cumberland
Potomac
Susquehanna
Hudson
Connecticut
Long Island
Lake Michigan
Lake Huron
Lake Superior
Lake Erie
Lake Ontario
Great Slave Lake
Great Bear Lake
Lake Winnipeg
Lake Manitoba
Lake Athabasca
Lake Nipigon
Lake Abitibi
Lake Timiskaming
Lake Nipissing
Lake Simcoe
Lake Champlain
Lake Memphremagog
Lake Moosehead
Lake Winnipesaukee
Lake Chautauqua
Lake Seneca
Lake Cayuga
Lake Oneida
Lake Onondaga
Lake Ontario
Lake Erie
Lake Michigan
Lake Huron
Lake Superior

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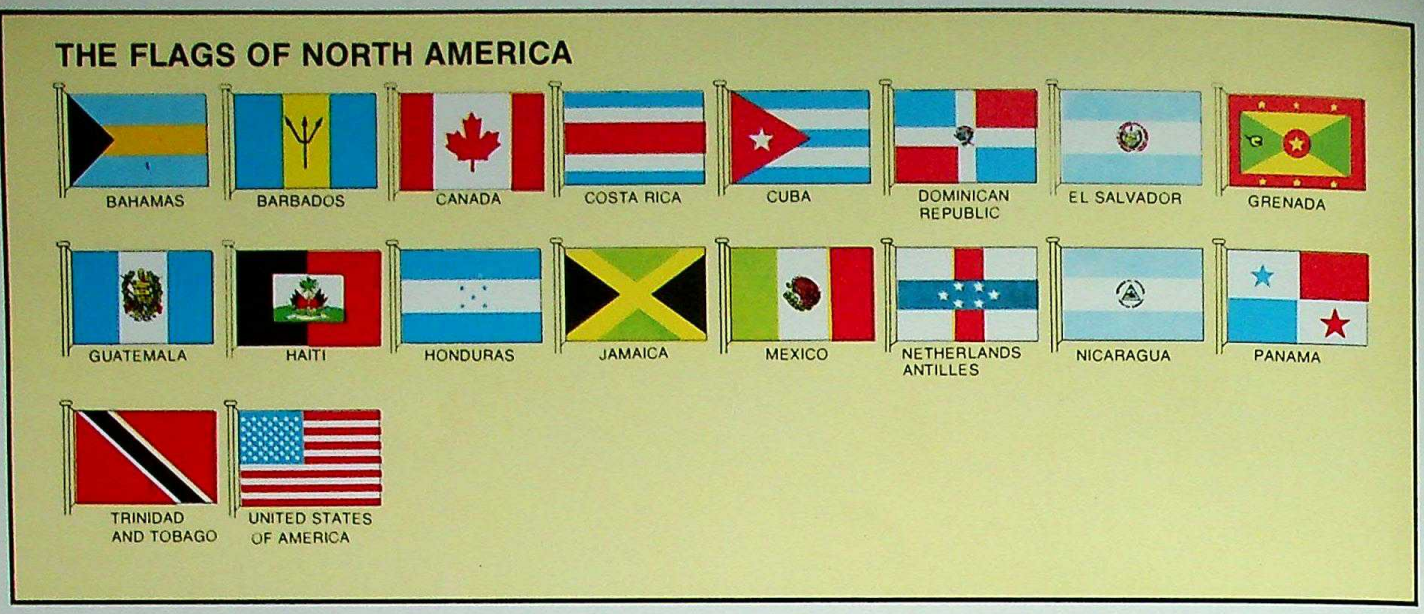

mostly Spanish-speaking. In some of these countries Indian languages are spoken. In the West Indies the chief languages are English, French and Spanish.

Christianity is the main religion in North America. In the US most of the population are Protestants. In Canada and Central America most people are Roman Catholics. This is due to the great French or Spanish influence.

Ways of Life

The ways of life of the people of North America also differ greatly from north to south. Agriculture employs less than 6 out of every 100 people in Canada and less than 4 out of every 100 in the US. About a quarter of the working population in these countries work in industry.

In Mexico mining is the most valuable industry, but agriculture employs 40 out of every 100 working people. Manufacturing is not very important, and Mexico's chief exports are farm products. In Central America and the West Indies, about two-thirds of the working population live on the land. Mining and manufacturing are not very important.

As a result, the people of Canada and the United States enjoy a far higher standard of living than the people to the south. The United States is, in fact, the most industrialized and the richest nation in the world.

The Mounties, or the Royal Canadian Mounted Police, were formed in 1873. They have the reputation that they 'always get their man'.

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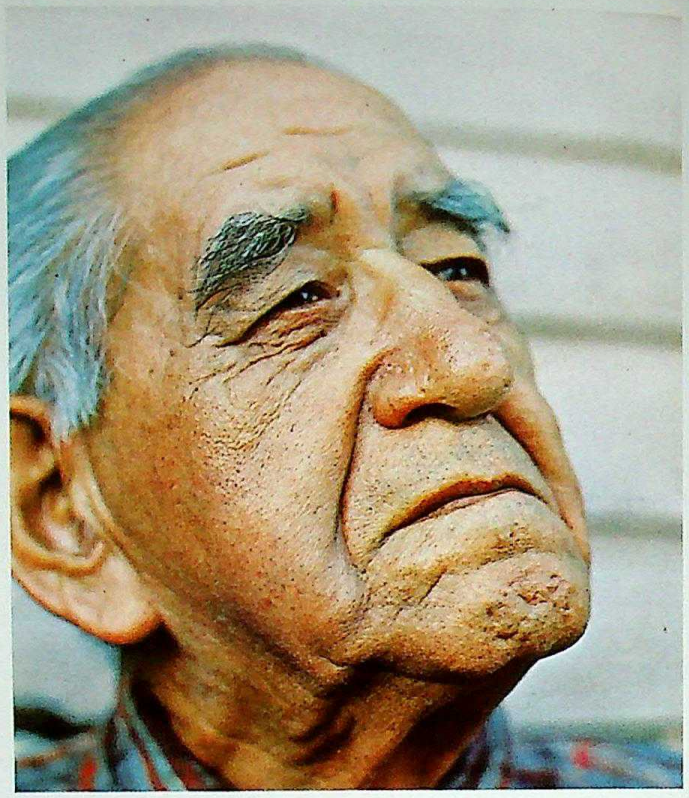
THE PEOPLES OF NORTH AMERICA



Above left: A typical Eskimo. The Eskimo differs genetically from the American Indian.
Above: An Algonkian Indian from the eastern United States, showing a typically Indian profile.

The Early Inhabitants

The original inhabitants of North America were the Eskimos of the far north and the American Indians, who lived throughout the region. The Eskimos and the American Indians entered North America from Asia during the Ice Age. The American Indians are so named because, when Christopher Columbus first reached the Americas in 1492, he thought that he had landed on islands near India. He therefore called the people *los Indios*, meaning 'the Indians'.

The American Indians were the first people to enter the Americas, possibly more than 25,000 years ago. They crossed from Asia through what is now the Bering Strait. However, in the Ice Age, so much of the world's water was frozen in ice sheets and glaciers that the sea level was much lower than it is today. As a result, the Bering Strait was dry and formed a land bridge between Asia and North America. The Eskimos went to North America much later, possibly by boat.

As the American Indians spread across the Americas, they developed different ways of life. At first, they were hunters, but later some of them learned how to farm the land. Some groups founded great civilizations.

The original people of North America can be divided into three main groups: the Eskimos; the Indians of Canada and the US, and the Indians of Mexico, Central America and the Caribbean.

The Eskimos

The Eskimos settled in the far north and lived by hunting caribou, fishes, seals, walruses and whales. They were short, stocky people with straight black hair and brown eyes, of typically Mongoloid appearance. They lived in family groups in tents during the summer and stout wooden or stone houses in winter. Some Eskimos lived in snow houses, called *igloos*, which were warmed inside by oil lamps. For transport, they made boats from wooden frames covered by hides. They also used sleds pulled by husky dogs.

The Indians

There were at least nine major groups of American Indians living in Canada and the US before the Europeans came. Most of them were hunters and fishermen. They also gathered berries and roots. Some of them, however, settled in permanent communities and farmed the land. They have often been called Red Indians because of the coppery tint of their skin. Like all the Indians who migrated from Asia, Red Indians belong to the Mongoloid race of peoples.

Best known of the Indians groups were the Plains Indians, who are familiar to us from countless 'Western' films. They roamed the plains between the Mississippi River and the Rocky Mountains. They hunted the buffalo (American bison), which grazed on the plains. At first they hunted on foot. Later they became expert horsemen, after the Spaniards had introduced the horse into the Americas. Among the best-known tribes of Plains Indians were the Cheyenne,

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Comanche, Crow, Pawnee and Sioux. The Sioux's famous chief Sitting-Bull defeated an American force led by General Custer at the Battle of Little Big Horn, in 1876.

In the south-west of what is now the United States lived a village people called *Pueblo*, who lived in large, terraced houses made of adobe (mud bricks). These people developed an advanced society based on farming.

The Middle American Indians of Mexico and Guatemala developed advanced societies. They included the *Mayas* and the *Aztecs*. The great Mayan civilization was at its height between AD 600 and 900. The Mayas were skilled astronomers and architects. The ruins of many of their magnificent stone cities and temples can still be seen. The Aztec civilization flourished from about AD 1200 to the 1500s. The Aztecs had a highly trained army and a complex religion. Their economy was based on farming, but many of the people lived in splendid cities. The Aztec empire collapsed after defeat by the Spaniards in 1521.

The Indians of Central America and the Caribbean Islands were divided into many small groups. Farming and fishing were important.

Indian cliff dwellings in the Mesa Verde National Park in Colorado, which date to the 9th-13th centuries.

No-one knows how many Indians lived in North America before the Europeans arrived. But contact with Europeans proved disastrous. Many Indians died of European diseases. Others died in battles with European soldiers and settlers. The introduction of alcoholic drinks to the Indians also did great harm to Indian society.

North America was colonized mainly by Britain, France and Spain. Today most North American countries are independent, but they retain many European features.

The French Quarter of New Orleans, which is noted for its beautiful wrought-iron balconies, was planned by a French architect in 1721.

Canada and the US

Canada and the United States are sometimes called *Anglo-America*, because of the English influence. Canada is part of the British Commonwealth of nations. The United States has been independent of Britain since 1776. From about 1840, European immigrants flooded into the United States from many European countries. The country was called a 'melting pot' of immigrants. The spread of settlers into the west and south-west rapidly reduced the lands of the American Indians. Wars and forced movements of the American Indians from their traditional hunting grounds to reserves caused much hardship and loss of life.

Canada today has about 270,000 Indians and 17,500 Eskimos in its 23 million population. Eskimos also live in northern Alaska and Greenland. The United States has about 600,000 Indians in its population of 214 million. This is certainly less than there were when the Europeans first arrived. But the population has increased

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American pioneers taking their wagons westwards in the late 1800s. They were attracted by the prospect of the West's rich grazing and farming land.

greatly since 1890, when the Indians numbered only 250,000.

Out of every 100 people in the US today, 88 are descendants of Europeans. Eleven out of every 100 are Negroes, or Black Americans. They are the descendants of slaves who were brought from Africa to work in the cottonfields of the southern states in the 1700s. Most Black Americans lived in the south-east, where the cotton plantations were. But after slavery was abolished, many Black Americans moved to northern and western cities. The remainder of the population of the US consists mainly of American Indians, Japanese, Chinese and Filipinos – people from the Philippines.

Mexico and Central America

Most people in Mexico and Central America are of Spanish, American Indian, or mixed Spanish and Indian ancestry. In Guatemala most people are of Indian origin. Most Costa Ricans, however, are of Spanish descent. Most people in El Salvador, Honduras and Nicaragua, and about three-quarters of all Mexicans, are of mixed origin. People of mixed origin are often called *Mestizos*. Belize and Panama have a black population.

Spanish is the official language of all the Central American countries, except Belize (formerly British Honduras). Belize is a self-governing British territory.

West Indies

Most West Indians are descendants of Black African slaves. But many people are of mixed origin, including British, Caribbean Indian, Chinese, Dutch, East Indian, French, Portuguese and Spanish. By far the largest of the West Indian islands are Cuba, Hispaniola, Jamaica and Puerto Rico. Most Cubans are white people of Spanish descent, and Spanish is the official language. The island of Hispaniola is divided into Haiti (west) and the Dominican Republic (east). Most Haitians are of Negro blood. They usually speak *Creole*, a type of French influenced by Indian, Spanish and English. The Dominicans are of mixed Spanish, Indian and Negro ancestry, and Spanish is the official language.

Jamaicans are mainly of Negro or mixed Negro and white blood. English is the official language. Many Jamaicans have emigrated to Britain over recent years, seeking better jobs and a higher standard of living. For much the same reasons, many Puerto Ricans have emigrated to the United States. Puerto Rico is a densely populated island, whose people are of Spanish descent. They are American citizens.

These two Guatemalan Indians are on their way to a local market to sell their wares. The lot of the Indian has improved little over the years.

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THE CLIMATE

North America has a very varied climate since it extends from the Arctic to the tropics.

Arctic Region

Most of Greenland and the northern parts of Canada and Alaska are north of the Arctic Circle. These areas are extremely cold. Northern Greenland, for example, has average January temperatures of −35°C (−31°F). The south is warmer, with average January temperatures of −7°C (19°F) and July temperatures of 5°C (41°F).

Canada

Icy Arctic winds bring most of Canada cold winters. However, the west coast of British Columbia has average January temperatures above freezing point, because onshore winds are warmed by the North Pacific current. Southern Canada has warm summers, when most of the rain falls. The interior prairies are therefore ideal for grain cultivation.

The rainfall varies between 2,500 millimetres (100 inches) in parts of the west, to between 300 and 500 mm (12–20 inches) on the prairies. South-east Canada has a moist climate. Central Ontario has about 750 mm (30 inches) of rain per year.

The United States

On the west coast of the US, the climate is affected by the Pacific Ocean. In California, which is called the 'Sunshine state', onshore winds bring a temperate climate all the year round. Inland, parts of the high plateaux are hot and dry. The rainfall decreases as you go farther south: the north-west is very wet, but the far south-west is desert. California has its rainfall mainly in the winter. It has a Mediterranean type of climate.

Westerly winds across the United States are blocked by the lofty Rocky Mountains. Beyond the Rockies, on the great plains, or prairies, rainfall is slight. Winters are usually cold, with

Above: The flaming colours of autumn in Vermont, which has a cool, temperate climate.
Below: The arid Arizona desert, where scarcely any rain falls.

temperatures falling to −40°C (−40°F) or below. Sometimes, however, warm winds called *chinooks* blow down the eastern slopes of the mountains. Summers on the interior plains are hot, reaching 38°C (100°F) or more. The climate has the extremes of the continental type of climate.

In the east the Atlantic coast and the south-east have hot, humid summers. The north-east has cold winters, caused by icy winds blowing from the interior. The south-east has warm winters, however. The southern tip of Florida lies just north of the tropics and has almost a tropical climate.

Tropical North America

Central America and the West Indies lie within the tropics. In most parts the climate is hot and humid. However, the climate is affected by the height of the land. Low-lying areas have temperatures of about 27°C (81°F) all the year round, and the air is very humid. But in mountainous and plateau regions, such as in Guatemala, the temperature varies between 16°C (61°F) in winter to 21°C (70°F) in summer.

The Caribbean region is affected by the intense tropical storms called *hurricanes*, which form over the Atlantic Ocean in late summer. These hurricanes bring howling winds, gusting at 160 km (100 miles) an hour or more. They also bring torrential rain. Some hurricanes veer north and strike the south-east and Atlantic coast of the US, sometimes causing terrible floods. In the Caribbean region generally up to 1,800 mm (70 inches) of rain falls on average each year.

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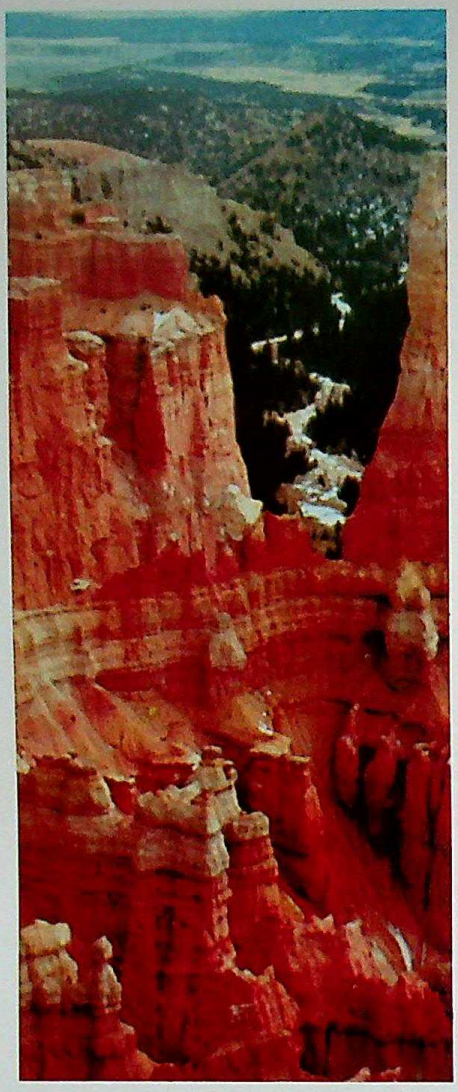
PHYSICAL FEATURES

North America is a continent that provides striking contrasts. In the far north Eskimos eke out a bare existence in the snowy wastes of the Arctic. Seven thousand kilometres (4,500 miles) to the south holidaymakers on the West Indian islands bathe in the tropical waters of the Caribbean.

Lofty mountains in the far west run in an almost unbroken line from Alaska in the north to Panama's border with South America in the south. Most of the rest of the continent is fairly low-lying by contrast. The interior is an almost continuous plain that stretches from the Gulf of Mexico in the south to the Mackenzie River Basin in the north.

In the south-west of the continent are vast tracts of hot, arid deserts, which form what is called the *Great Basin*. Rain may not fall for a number of years in these deserts. The tropical lowlands of Central America, however, are hot and humid. Heavy rain falls throughout the year.



Right: The colourful, highly eroded landscape of Bryce Canyon, Utah. Below: Kakabeka Falls, Ontario, in the icy grip of winter.

The highest point in North America is Mt McKinley, near Fairbanks, Alaska, which is 6,194 metres (20,320 feet) above sea level. The lowest point is 86 metres (282 feet) below sea level, in Death Valley, California. The longest rivers include the Mackenzie (4,240 km, 2,635 miles) in Canada, and the Mississippi and the Missouri in the United States. The Mississippi–Missouri system finds its greatest length (6,021 km, 3,741 miles) if the Red Rock River (a tributary of the Missouri) is included. In all it drains an area of some 3,250,000 square kilometres (1,250,000 square miles).

The Great Lakes between the US and Canada are, in order of size: Lakes Superior, Huron, Michigan, Erie and Ontario. Lake Superior, whose area is 82,100 square kilometres (31,700 square miles), is the second largest lake in the world. Together, the Great Lakes form the most important waterway in North America. Since the opening of the St Lawrence Seaway, ocean-going ships can sail from the Atlantic into the Great Lakes.

The Niagara Falls on the US/Canada border lies on the Niagara River between Lakes Erie and Ontario. It is divided into the 800-metre (2,600-feet) wide Horseshoe Falls on the Canadian side, and the 300-metre (1,000-feet) American Falls on the US side. The American Falls drop 59 metres (193 feet), which is 2 metres (6.6 feet) more than the Horseshoe Falls. Something like 3,000 tonnes of water pour over the whole Falls every second. The highest waterfall in North America is Yosemite Falls in California, with a drop of 739 metres (2,425 feet).

In the pages that follow we describe the main land regions of North America. They can be divided into the far north, the mountains, the central plains, the deserts, the coasts and Mexico and Central America (including the West Indies).

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THE FAR NORTH

The Canadian Shield

The Canadian shield takes in a vast stretch of central and northern Canada. It is at its highest (about 600 metres, 2,000 feet) along the shores of the Great Lakes. It slopes gently northwards towards the clay lowlands of Hudson Bay. The shield forms a great horseshoe of land of more than 2,500,000 square kilometres (1,000,000 square miles) around Hudson Bay.

The shield consists of very old (Precambrian) rock, which has been worn down by hundreds of millions of years of erosion. The glaciers of the last great Ice Age gave the region its distinctive landscape. This huge, rocky plain has been scoured clean of most of its soil. All that is left is barren rock dotted with countless small lakes. The little soil that does remain supports a hardy coniferous forest over the southern parts. Numerous rivers criss-cross the region and provide a plentiful supply of hydroelectricity where they have been harnessed.

The rocks of the Canadian Shield are a great source of mineral wealth. They have made Canada one of the world's foremost producers of copper, nickel, iron, gold, asbestos, zinc, uranium, platinum and titanium. Many of the mineral deposits are found in remote parts of the region.

The Arctic

More than 5,000,000 square kilometres (2,000,000 square miles) of Canada and the US state of Alaska lie north of the Arctic Circle. Conifer forest grows up to the Arctic Circle in the Mackenzie River Basin, which forms the northern part of the great central plains of the continent. The vast coniferous forests of the Basin support a large timber and pulp and paper industry. The rivers provide the hydroelectric power this industry requires.

North of the tree line is a belt of barren tundra that stretches to the shores of the Arctic Ocean. Beyond is the network of islands of the Canadian archipelago. The largest islands include Baffin, Ellesmere, Victoria and Banks islands. The entire region is a frozen wilderness, where life is harsh for the few Eskimos and trappers that live there. More people have been drawn to the northern slope of Alaska in recent years following the discovery of petroleum there.

Large areas of Canada's Arctic islands are permanently covered by ice and snow. Practically all of Greenland is. Greenland is separated from Baffin Island by the waters of Baffin Bay, and by the narrower Nares Strait from Ellesmere Island farther north. With an area of 2,175,600 square kilometres (840,000 square miles), Greenland is the world's largest island.

Only one-sixth of the land is ever free from ice and snow. This is the region near the coast, where the capital Godthaab and a few other towns are located. Inland is a vast icy plateau averaging about 1,400 metres (4,600 feet) above sea level. In places the ice is more than 3,000 metres (10,000 feet) thick. Coastal mountains often rise to more than 2,400 metres (8,000 feet) and peak at Mt Gunnbjørn (3,700 metres, 12,140 feet).

Ice floes litter the sea around Kulusuk, an island off the east coast of Greenland.

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THE MOUNTAINS

On either side of North America lie mountain systems that run the greater part of the length of the continent. In the east are the Appalachians, a low, smooth mountain range extending for about 2,400 km (1,500 miles). It is ancient and highly eroded. In the west lie the high, jagged Rocky Mountains, which stretch for more than 4,800 km (3,000 miles). This range is quite young by geological standards. It was upthrust only about 70 million years ago, as compared with 600 million years for the Appalachians.

The Rocky Mountains are sometimes thought to be the entire system of peaks, plateaux and valleys in the west of North America. But in fact the Rockies are only one chain of peaks. The mountains nearer the Pacific coast form other great chains, the Sierra-Nevada-Cascade and Coast Ranges. All of these great mountain systems form part of Cordilleran chain, which extends from Cape Horn at the tip of South America to the Arctic.

The jagged peaks of the Rockies in Glacier National Park, Montana, where some 60 glaciers remain from the last Ice Age.

The Rockies

The Rockies form a continuous rampart of mountains extending from northern Alaska and the Yukon, through British Columbia, into Montana, and on south into New Mexico. In the Canadian Rockies there are many peaks over 3,300 metres (11,000 feet). Highest is Mt Robson (3,954 metres, 12,972 feet). Farther south lie the Northern Rockies of the United States in Idaho, Montana and Wyoming.

In Wyoming the Rockies widen into a rugged plateau averaging about 2,100 metres (7,000 feet) above sea level. They change from being a continuous wall into a confusing cluster of mountains and valleys running in a number of directions. Here they also become known by other names such as the Bitterroot Range and Bighorns, Tetons and Wasatch Mountains. The mountains present no serious barrier to travel in this region, which is called the Wyoming Basin.

South of the Wyoming Basin, the Rockies become narrower again and rise to great heights. There are many peaks over 4,000 metres (13,000 feet) high in this section. They include Pike's Peak (4,300 metres, 14,110 feet) near Denver, Colorado. Nearing the Mexican border the mountains slope down into a high plateau. However, a narrow branch continues on into Mexico as the eastern ridge of the Sierra Madre.

The Rocky Mountain system possesses a vast mineral wealth throughout its length. Copper, silver, molybdenum, zinc and lead ores are among the valuable minerals mined. In Wyoming countless millions of barrels of oil lie locked in a massive oil-shale formation.

The *Great Divide*, or *Continental Divide*, runs the length of the crest of the Rocky Mountains. It is a line that marks the boundary between rivers that flow to the east and those that empty into the Pacific or Gulf of California in the west.

Sierra-Nevada-Cascade

Running more or less parallel to the Rockies, but closer to the Pacific coast is another chain. In California it is made up of the Sierra Nevada. Farther north it includes the Cascade Range. Smaller ranges, such as the Selkirk Mountains, lie scattered between the two main systems. These various ranges are divided from each other by a series of valleys and basins. They are very dry areas for they lie in the rain shadow of the surrounding peaks. Where water is available and the climate is suitable, however, excellent fruit and vegetable crops are grown in these valleys, particularly in the Cascade Range. Along the coast itself is another mountain system – the Coast Range.

The highest peak of the Sierra Nevada is Mt Whitney (4,418 metres, 14,495 feet). The Cascade Range also has a number of peaks over 4,000 metres (13,000 feet). The Coast Range is low in California but rises to 6,050 metres

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(19,850 feet) at Mt Logan in the Yukon, in Canada. Mt Logan is the second highest peak in North America. It is only exceeded in height by Mt McKinley (6,194 metres, 20,320 feet) in the Alaska Range to the north-west.

The Appalachians

The Appalachians are a very old range of folded and worn rocks. Once, in the past, they towered as high as the Rockies. But today their highest point, Mt Mitchell in North Carolina, is only 2,037 metres (6,684 feet). In most places they are considerably lower than this. The Appalachian mountain system runs north-east from northern Alabama as far as the rolling hills of the St Lawrence Valley and the Gulf of St Lawrence in the north-east.

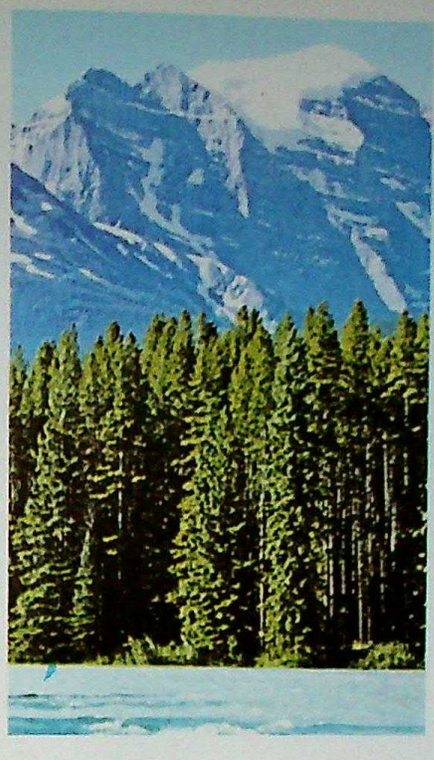
To the east of the main range lies an undulating wooded plateau. This is called the Piedmont ('foot of the mountain') region. The rivers that tumble from the plateau to the Atlantic lowland plain generate electricity for the cities of the coast. The beautiful Blue Ridge Mountains are the first line of the Appalachians. They rise to over 900 metres (3,000 feet) as a long chain of peaks from Pennsylvania to northern Georgia.

West of the Blue Ridge range is the main Ridge and Valley region of the Appalachians. The region consists of a series of long valleys running parallel to each other and separated by ridges. The ridges are of sandstone. This has resisted erosion better than the soft rock of the valley floors.

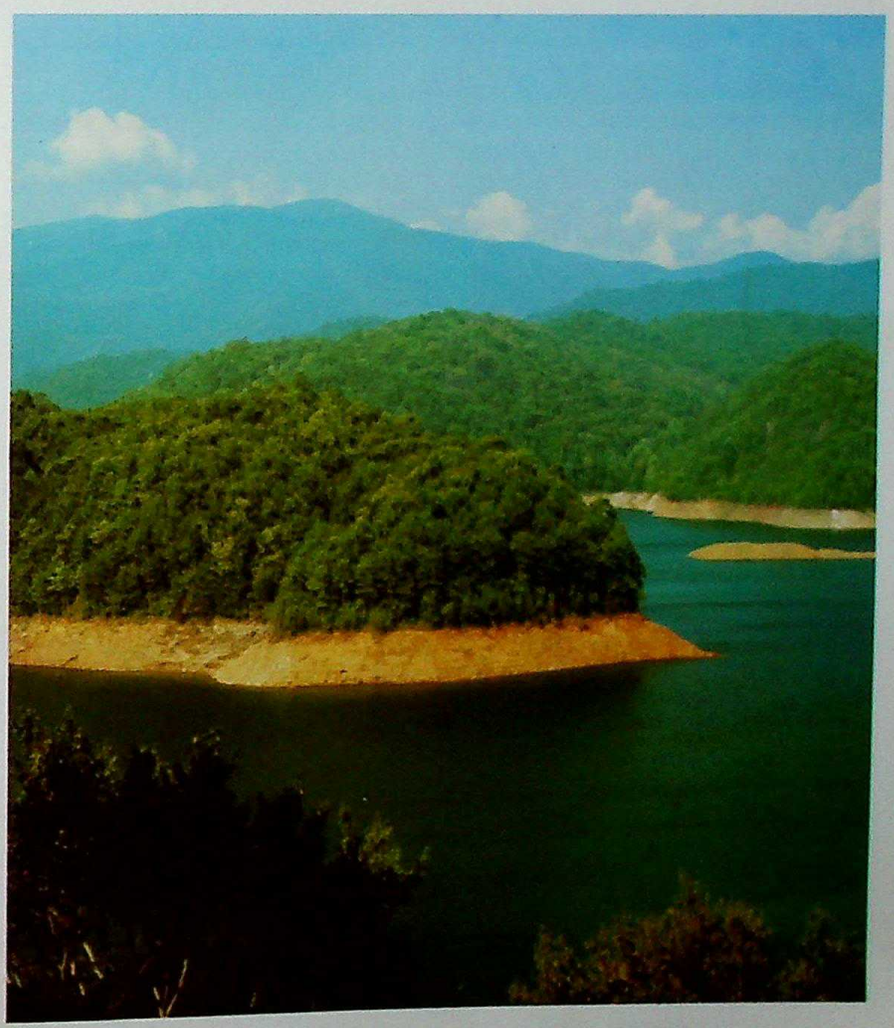
Farther west, the mountains become a plateau some 600 metres (2,000 feet) high. A large region of the Appalachian Plateau is founded on coal deposits. Thick seams lie close to the surface in many places. The area is in fact the world's greatest coal-field. The coal deposits extend into Ohio, West Virginia, Kentucky and Alabama. The Appalachian region produces three-quarters of all the coal in the United States, including top-quality anthracite from Pennsylvania.

The northern plateau region around Pittsburgh, in Pennsylvania, is the site of many industries, including iron and steel and chemicals. By contrast, the southern part of the Appalachians is a region of great poverty. The soil is poor, and the region is isolated from main roads and towns. Poor farming methods and careless strip-mining have severely eroded the hills and valleys and were the cause of major floods along the Tennessee and Ohio Valleys.

In 1933 the Tennessee Valley Authority (TVA) was established to deal with the problems of part of the area. Since then, the TVA has taken control over 104,000 square kilometres (40,000 square miles) of Appalachia and built 20 dams to control flooding and generate some 13 million kilowatts of electricity. In addition a 1,000-km (625-mile) shipping channel has been built along the Tennessee River. And many projects to halt erosion, and to develop local resources and industries have been started.



Above: The Canadian Rockies near Jasper, Alberta.
Below: Fontana Lake in the Great Smoky Mountains, part of the Appalachian chain.



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THE CENTRAL PLAINS

The lowlands and plains of North America sprawl across the entire interior of the continent. From the Appalachians in the east to the foothills of the Rocky Mountains in the west, the Central Plains stretch for over 1,900 km (1,200 miles). They extend northwards some 4,000 km (2,500 miles) from the edge of the Gulf Coast plain of Texas to the mouth of the Mackenzie River within the Arctic Circle. Here they lie squeezed between the Rockies and the Canadian Shield.

This vast area of the Central Plains is the greatest farming and grazing region in the world. Even the far northern region is productive, with lumbering being the main activity. The great grasslands farther south are often called the *prairies*. The drier and higher western part of the Central Plains is often called the Great Plains. In Canada the Great Plains cover large areas of Alberta, Manitoba and Saskatchewan, the 'breadbasket' of Canada. In the United States the Great Plains include the states of Iowa, Kansas and Nebraska, which have some of the richest farmland in the world.

In the United States the Central Plains form the drainage basin of the vast Mississippi–Missouri river system. East of the Mississippi the average level of the land is below 300 metres (1,000 feet). West of the Mississippi, the land begins to rise gently and evenly towards the Great Plains region. These plains continue to slope steadily upwards to a height of 1,200 metres (4,000 feet) or more. They gradually merge with the rolling foothills of the Rockies.

The flat monotony of the Central Plains is broken only twice. In South Dakota, the dome-shaped Black Hills rise sharply above the surrounding prairies. On the edge of the coastal plains west of the Mississippi lies the Ozark Mountains. It is a region of narrow ridges and valleys that resembles the Appalachians in many ways. This cluster of highlands never rises more than 839 metres (2,753 feet) above sea level.

Rainfall and Temperature

Rainfall in the Central Plains varies from place to place. Agriculture and settlement in this part of the continent closely follows the pattern of rainfall. East of the Mississippi, rain is plentiful all year round. This area was once a region of great deciduous forests. Today, most of it is farmland. The northern end of the Mississippi Valley cuts through the so-called Corn Belt of the mid-west. This is a 650,000 square-kilometre (250,000 square-mile) plain of fine, fertile land, where the soil is rich and deep. The climate is warm to hot and the rainfall is well distributed during the growing season.

To the west, rainfall diminishes. The plains here are carpeted naturally with tall prairie grass. Nowadays, this country is the heart of a great sea of wheat. Farther west rainfall is less than 500 millimetres (20 inches) a year and the prairie grass grows shorter. Winter wheat is farmed throughout the region. At the westernmost edge of the plains

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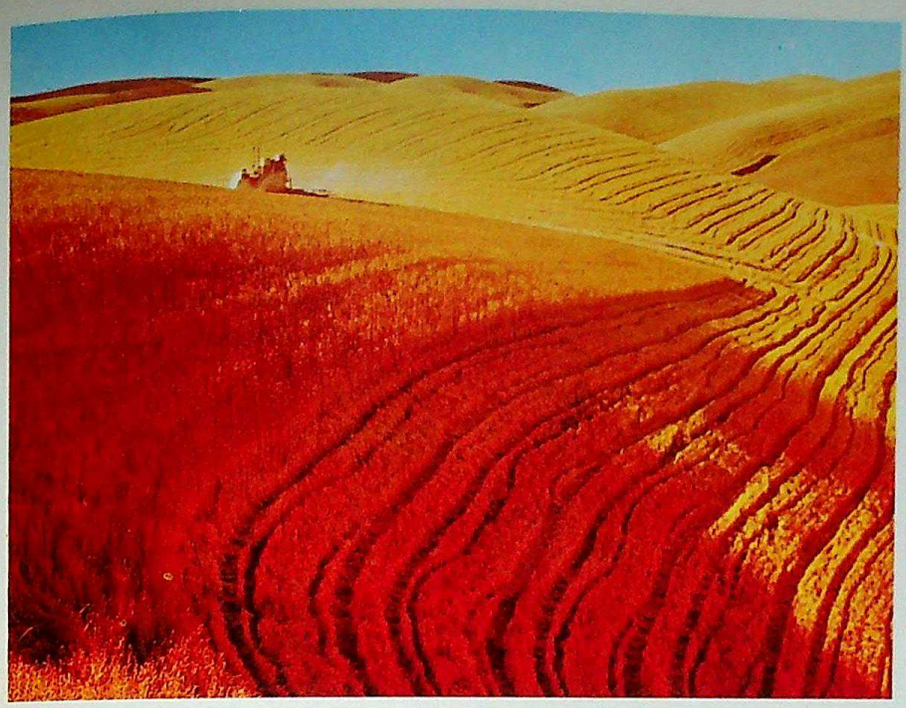

The Great Plains region of North America provides ideal conditions for ranching cattle (left) and growing cereals. Harvesting would be a nigh-on impossible task without combines (above).

lies the shifting boundary between farming and grazing land. In wet years, crops can be raised. In years of drought, the land is far too dry even to be ploughed.

The rain received by the Central Plains is blown inland from the Gulf of Mexico. Most of it falls during the summer, but the amount that falls varies from year to year. In dry years, rainfall may be less than a quarter of the average. In the past, droughts have turned large regions of once-fertile prairies into dry dirt and dust wastelands. In the 1930s a series of dry years transformed parts of Texas, Oklahoma, Nebraska and Kansas into a giant dust-bowl. Hundreds of tons of topsoil were blown away by the wind. Many families saw their farms completely ruined.

Temperatures on the prairies are truly continental in their range. The difference between the sweltering highs of summer and the coldest days of winter may be as much as 85°C (153°F) in the north. The weather of the plains is also notable for the astonishing speed at which it can change. Devastating hailstorms and tornadoes may spring up in an instant to ravage the crops. In winter raging blizzards sweep across the open plains burying roads and half-covering houses with snow drifts. Many livestock are killed through cold. Others starve to death when the pasture is buried under the snow.

Settlement

Prior to the arrival of white men, the interior plains of North America were the home of wandering tribes of Indians. They hunted the huge herds of bison that roamed the rich grazing land. Late in the 1800s a rush to develop the west brought thousands of settlers to the plains. First came the ranchers attracted by the rich grazing land. Then came the farmers who fenced in the open spaces and ploughed up the land to plant wheat.

Today, the entire continental interior has been settled, with crop and livestock farming as the main occupations. Wheat, corn (maize), soybeans, hay and, in the south, cotton are important crops. Cattle and sheep are grazed on the prairies and pigs are raised in large numbers in the mid-west.

Vast amounts of fossil fuels are found beneath the Central Plains. Alberta in the north and Kansas, Oklahoma and west Texas in the south produce much of North America's oil and natural gas. In Ohio and Illinois coal is mined on a large scale. The major industries of the prairies include processing of the mountains of grain and meat that are produced here. Towns like Chicago, Winnipeg, Minneapolis–St Paul, St Louis and Kansas City have all grown up as centres of flour milling and meat packing.

This kind of agricultural settlement is typical of that in the American Mid-west.

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THE DESERTS

Two types of desert exist in North America. There are those with hot and arid climates, and those which are permanently cold. Both are inhospitable and unlikely places for people to live, but many have made their homes there.

The hot deserts of North America lie in the south-west of the continent. They extend across the states of California, Nevada, Arizona, New Mexico, Utah and Colorado as well as northern Mexico. The entire area is often known as the Great Basin. It is a land of mountains interspersed by arid desert basins. These features are especially common in Nevada and Utah.

The Great Basin is a region of some 490,000 square kilometres (190,000 square miles) stretching east–west from the Sierra Nevada to the Rocky Mountains. It extends in the south to the Mojave Desert in southern California and continues through the Sonora Desert of southern Arizona into Mexico.

Another kind of desert formation is found in the Colorado Plateau. Here, softer rocks have been eroded by wind, leaving behind scattered outcrops of harder rock known as *buttes* and *mesas*. These are soaring pillars of flat-topped rock. Their vertical cliffs are littered at the base with the debris of eroded rock. To the north-west of the Colorado Plateau is the so-called Painted Desert where the deeply eroded landscape is coloured bright red and yellow by the minerals in the rocks.

Rainfall and Temperature

The prevailing winds of the south-west deserts blow from the Pacific Ocean. They shed much of the moisture they pick up from the cold Japan Current off the west coast on the high ridges of the Coast Mountains and the Sierra Nevada. The Great Basin lies to the east in a rain shadow. Rainfall is extremely irregular and is often much less than 200 millimetres (8 inches) a year. When rain does come, it usually falls as violent cloudbursts in the desert mountains. The sudden flood of water rushes down the steep slopes, gouging out narrow ravines and sweeping away loose material. This rocky debris is deposited in the desert basin below.

The rainwater pouring off the peaks may form a temporary shallow lake in the desert before it seeps into the ground or evaporates. If the supply of water is large enough, the lake may become permanent. The Great Salt Lake in Utah and the Salton Sea in southern California are lakes of this kind. Evaporation concentrates the amount of salt such lakes contain. If they eventually do dry up, thick deposits of salt known as *playas* remain. The

In the arid Colorado Plateau, the San Juan river has cut this 300-m-deep looping canyon known as the Gooseneck.

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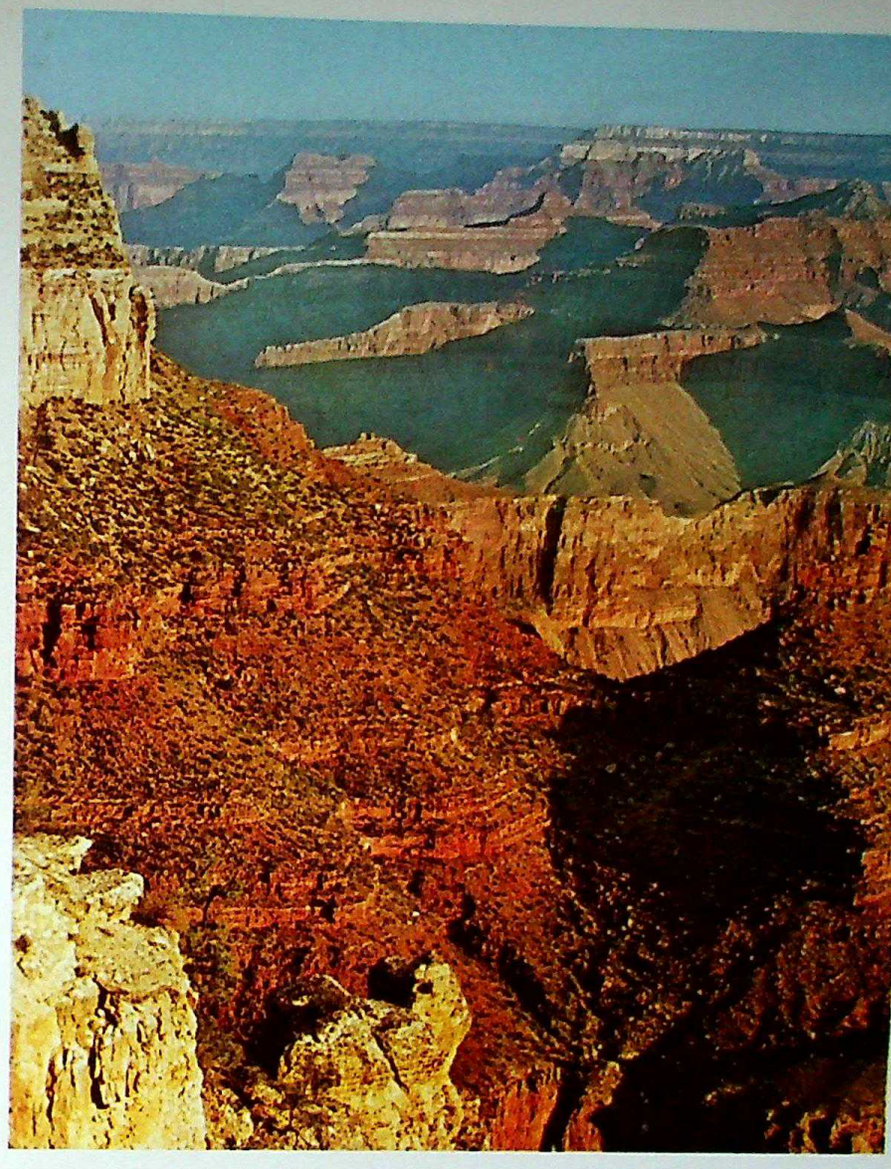
Bonneville Salt Flats of Utah were formed in this way.

Temperatures in the desert vary enormously from day to night. The daytime high has been known to soar to 57°C (134.6°F) in Death Valley, New Mexico. In parts of Arizona, daytime maximum temperatures of 37°C (98.6°F) and over have been recorded for up to 2½ months at a time. Yet nighttime temperatures in these same regions commonly plunge to a chill 10–15°C (50–59°F). Death Valley, incidentally, contains the lowest point on land, not only in the United States, but in the whole Western Hemisphere. It lies 86 metres (282 feet) below sea level. Death Valley itself is a 200 km (125 miles) long trough in the Earth's crust up to 23 km (14 miles) wide.

Irrigation

There is precious little water in the American deserts. Where it does exist, though, it can be used to irrigate the land and make the desert bloom with life. Groundwater in the desert may lie very deep, but it can sometimes be tapped with wells. Sometimes artesian wells are found in which water flows to the surface like a natural spring. Rivers are naturally very rare in the desert regions. The only ones of importance are the Colorado and its tributaries, such as the Gila, Green and Virgin rivers. These rivers are fed in rainy, mountainous areas and then flow through the arid country on their way to the sea.

In north-west Arizona the Colorado River has carved a very deep gorge, or *canyon*, into the desert plateau through which it passes. Known as the Grand Canyon, it has some of the most spectacular scenery in the world. It is more than 1,700 metres (5,500 feet) deep in places, and is between 3 and 30 km (1.9–18.6 miles) wide. The floor of the Grand Canyon is far too deep for water to be pumped up to irrigate the surrounding desert. However, further downstream the river is used for a number of irrigation projects. Near the Mexican border water is diverted into the All-American Canal. The water it carries transforms the desert of Imperial Valley into fertile farmland. The mild winter climates make these former deserts one of the main regions of winter fruit and vegetable production in the nation.



One of the most fantastic sights on Earth, the mile-deep Grand Canyon, in North Arizona.

Even in some places that are not irrigated the desert contains sufficient scrub vegetation to allow limited sheep and cattle grazing. Enough desert grass grows among the creosote brush, sage, thorn and cacti to support livestock. Parts of Nevada and Utah in particular have been given over to ranching.

People have been drawn into the desert regions for reasons other than farming. Mining has attracted people ever since the mid-1800s. The Great Basin contains many valuable mineral deposits, including silver, copper, zinc, uranium and petroleum.

The Cold Desert

The extreme north of the continent is also a region of desert. At the northern edge of the tundra zone, plant life is reduced to no more than a few hardy mosses and grasses. The rest of the land is barren and frozen. As most of the water is turned to ice, the region is a very dry desert. Even during the brief summer, the ground never thaws out more than a few centimetres. The permanently frozen soil is called *permafrost*.

Farther north still lies the region of permanent snow. This is an icy polar desert in which no land plants can survive. The few animals that live here, such as polar bears and seals, find their food in the sea.

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THE COASTS

The coastline of North America is one of the longest of any continent – about 63,000 km (39,000 miles). A flat plain runs all along the Atlantic and Caribbean shores from Mexico to New England. It is heavily indented by the sea. In contrast, on the west coast, the mountains and the sea meet quite abruptly and form a comparatively straight shoreline.

Miami Beach, in southern Florida, boasts a sunny climate, sandy beaches and fine hotels.

The East Coast

North of the Gulf of St Lawrence, the eastern rim of the Canadian Shield forms a bleak and inhospitable shoreline in Labrador. The Labrador coast is bitterly cold because of the icy Labrador current coming from the Arctic. Farther south, the rugged coast of Canada's Maritime Provinces has many deeply indented bays and sunken valleys. In the Bay of Fundy the world's highest tidal range occurs. High water may be more than 12 metres (40 feet) above low water. A power scheme is planned for the Bay which will harness the tidal rise and fall to produce electricity. Halifax and St John are the two most important deep-water ports on the eastern coast of Canada. The warming influence of the sea keeps them free of ice throughout the year.

The coast of the north-east United States – the part of the US known as New England – is a jumble of islands and bars of sand and shingle. The long arm of Cape Cod is a sandy spit of land that marks the boundary between the cold waters of the Labrador Current and the warm waters of the Gulf Stream. Cape Cod is a region of frequent fogs, caused by the mixing of the cold and the moist, warm air as the ocean currents merge.

The New England coast is washed by the cold Labrador Current. These waters are major fishing grounds. Fishing has always been one of the main activities of the small villages scattered along this coast.

The massive coastal plain that borders practically the entire east of the continent first appears around New York City. The mouths of many of the rivers that cross this plain form excellent harbours all along the coast. New York, Philadelphia and Baltimore are among the cities built on such harbours.

Going south from New York, the coastal plain widens out. It slopes to the sea so gradually, however, that no definite shoreline exists. The edge of the land is marked indistinctly by swamps and lagoons. Slightly offshore, ridges of sand run parallel to the coast. The coast is sandy and dotted with pines, and is a great attraction to tourists. The sandy soil is not particularly fertile, yet a great many truck farms – market gardens – are found throughout eastern New Jersey and Maryland.

In the southern states of Virginia, Carolina and Georgia, the coastal plains are sandy or marshy and not very fertile. Great stands of pine forest occupy this region. In a number of places farmers grow tobacco. Numerous islands dot the coast. The finest cotton in the world – sea-island cotton – is grown here.

The Florida Peninsula is the southernmost part of the Atlan-

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tic coastal plain. The whole region averages less than 30 metres (100 feet) above sea level. The coast is a tangle of salty marshes and lagoons. The southern part of Florida is a 13,000-square-kilometre (5,000-square-mile) area of swamp called the *Everglades*. The climate is almost tropical, and mangrove swamps thrive along the shore.

The Gulf Coast

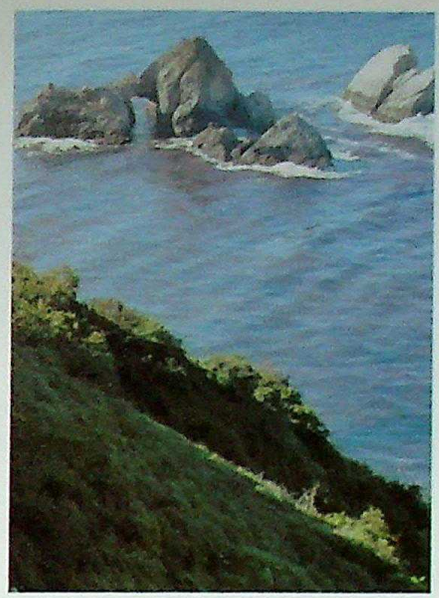
The west coast of Florida merges with the subtropical lowlands of the Gulf Coast. East of Texas, this coastal region receives more than 1,150 millimetres (45 inches) of rain a year. Towards the Texas–Mexico border, only about half this amount of rain falls each year. This hot, muggy coast is a region of cypress swamps and lagoons. The waters of the Gulf of Mexico are shallow. Harbours in the Gulf rapidly become silted up because there are no strong currents or tides to carry the sand and silt away. The main ports of the deep south are New Orleans and Mobile. They ship out the farm products of the region.

The semi-tropical climate of the Gulf Coast is ideal for growing crops such as rice and sugar cane. Large plantations near New Orleans produce nearly a fifth of the country's sugar. The rich black soils of the Mississippi delta are very fertile. Winter fruit and vegetables are grown in a number of places. But much of the delta is still a sparsely populated wilderness of salty marshes and swamp.

West into Texas, the coast and shallow waters of the Gulf overlay enormous deposits of oil, natural gas, sulphur and rock salt. In this region the coastal plain extends nearly 480 km (300 miles) inland. It is dotted with thousands of oil rigs. Giant refineries and chemical plants which manufacture various petroleum products are located along the coast. Houston and Galveston are the main ports.

The West Coast

The west, or Pacific coast of North America is another world entirely. A range of low hills runs



Most of the Pacific coast of North America is rocky.

along much of the coast of California. In the south of the state a narrow ribbon of plain follows the shoreline. In the Los Angeles basin considerable quantities of oil have been found. The climate there is similar to a Mediterranean one. Summers are arid and hot, while winters are mild and relatively rainy. No more than 250–380 mm (10–15 inches) may fall in the south each year, but farther north the climate becomes wetter and cooler.

The north-west Pacific coast is renowned for its spectacular scenery. Along the coast are the beautiful Olympic Mountains, which rise to a height of 2,400 metres (8,000 feet). They receive very heavy rainfall. So do the Coast Ranges slightly farther inland. These mountains support forests of redwood and pine. The major industry of this region is logging. Thousands of sawmills operate throughout the area. Salmon fishing is another important activity along this coast. The inland valleys are one of the major fruit-growing regions of the country. The cool summers and mild winters are ideal for this.

North to Alaska, the coast remains very rugged, with the Coast Ranges rising to towering peaks a little way inland. The climate becomes increasingly cold. The slopes of the mountains are covered with thick forests of pine. The isolated settlements along the coast are mainly engaged in fishing or logging.

Okefenokee Swamp, a primitive coastal swamp and wildlife refuge in northern Florida.

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MEXICO & CENTRAL AMERICA

As a geographical region, Mexico is a natural extension of the United States. The coastal plain of the Gulf of Mexico, the Rocky Mountains and the high plateau of the south-west United States all continue hundreds of kilometres southwards into the middle of Mexico.

The heart of Mexico is a high plateau ringed by mountains. This Central Plateau, or Mesa Central, lies some 1,200 to 2,400 metres (4,000–8,000 feet) above sea level. Although it is in the tropics it enjoys a temperate climate all year round, because of the altitude. Rainfall is light but is enough to support good crops of wheat and corn (maize).

The bulk of the country's population live in the Central Plateau. The two largest cities in Mexico, Mexico City (Ciudad de México) and Gaudalajara, are located there. Hydroelectric power from the surrounding mountains has attracted industry.

Mexico City lies near the southern edge of the plateau in the fertile valley of Mexico. Just to the south of it is a line of volcanoes, some of which are still active. They include the twin peaks Popocatépetl (meaning 'smoking mount') and Ixtacihuatl ('sleeping woman'). Popocatépetl soars to 5,450 metres (17,880 feet).

North of this plateau lies a vast arid plain which extends into the Colorado Plateau and the Great Basin area of the United States. Vegetation in this semi-desert is limited mostly to scrub and cactus. In places where rainfall is less scanty, enough grass grows to graze sheep and cattle.

The Sierra Madre

The Central Plateau is flanked on each side by the Sierra Madre Mountains. The eastern peaks – the Sierra Madre Oriental – are more or less a continuation of the Rockies. They pose no major obstacle to travel, as they are cut by river valleys in a number of places. To the east, these mountains drop away to the lowlands of the Gulf Coast. This coastal plain extends in an arc round to the Yucatan Peninsula.

Mexico City is ringed by mountains. It was built on the ruins of the Aztec city of Tenochtitlán.

This hot, tropical coastal plain has a weaving shoreline of mangrove swamps and shallow lagoons. For years its unhealthy, feverish climate caused this part of Mexico to be ignored. But these days bananas, cotton, coffee and other tropical crops are cultivated there. The Gulf coast also has important oil fields. The chief coastal towns are the ports of Tampico and Veracruz.

The mountains west of the Central Plateau are known as the Sierra Madre Occidental. They are a chain of rugged peaks that form a major barrier to communications with the coast. Few roads pierce the mountains, which are one of the most backward and isolated parts of the country. In the north-west is the arid Sonora Desert. Across the Gulf of California is the narrow peninsula of Baja (Lower) California. The peninsula has rugged mountains in the east and arid deserts in the west. The Pacific coastlands to the south receive much greater amounts of rain, and the wooded country there is more heavily settled.

Central America

The highlands that rise in the south of Mexico become a great chain of mountains that run through the entire length of Central America like a backbone. A number of volcanoes are dotted throughout this chain of peaks. Some are still active. Earthquakes can also occur.

The mountains of central America form an irregular series of ridges that make travel from one country to another very difficult. The northern part of the range soars to more than 4,000 metres (13,000 feet) in places. It runs through Guatemala, Honduras and El Salvador into Nicaragua. The southern part of the range runs from Nicaragua through Costa Rica and Panama. Between the northern and southern sections in Nicaragua is a flat inland plain containing the large Lake Nicaragua. This lake is the largest freshwater lake in North America south of the Great Lakes. The mountain system shelters the Pacific coast of Central America from much of the rain carried by the Atlantic trade winds. For this reason, the Pacific coast is quite dry during the winter. It receives the greatest amount of rain in the summer when the moist monsoon blows in from the Pacific.

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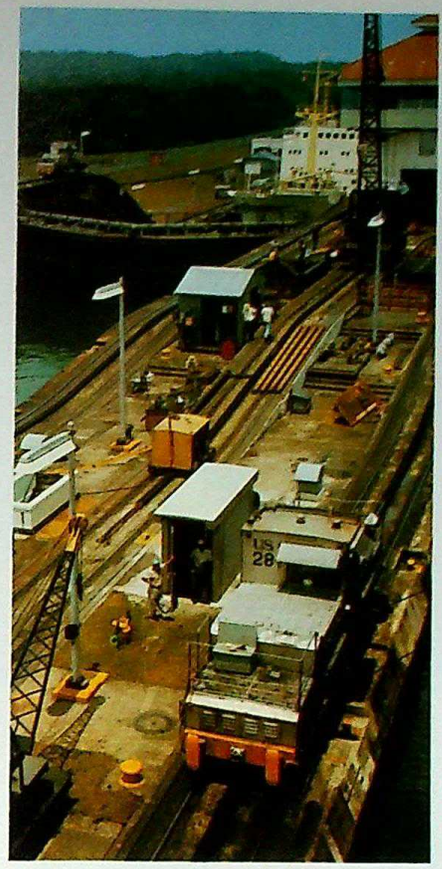
Climate and Vegetation

The changes in climate and vegetation in tropical Central America are determined mostly by altitude, as they are in much of Mexico and tropical South America. Below about 600 metres (2,000 feet) the climate is tropical. This zone is often called the *tierra caliente* ('hot land'). It includes the low coastal plains. They were formed from sediments washed down from the mountains. On the Atlantic coast the plain is nowhere wider than 80 km (50 miles). It is a humid area of lush jungle and swamp. Rainfall is high all the year round, making this an unpleasant place to live. The coast was largely neglected until this century, when the cultivation of tropical crops became important. Bananas, cacao, sugar, rice and coconuts are the major crop grown. The thick forests of the plain supply a great deal of timber.

The temperate zone (the *tierra templada*) covers altitudes between about 600 and 1,800 metres (2,000–6,000 feet). It is the most attractive region for human settlement. Nearly four-fifths of all Central Americans live in it. Hardwood forests abound, and the rich volcanic soils are excellent for farming. Coffee, sugar, cotton and tobacco all thrive. Above lies the cool zone, the *tierra fria*. Cereals are grown and livestock are raised there.

On the Pacific coast of Central America the mountains plunge steeply to the sea, leaving only a very narrow strip of plain. As this coast is quite dry during the winter months, the vegetation is far less luxuriant than on the Atlantic side. Patches of grassy savanna intersperse with forest.

The narrowest point of South America is the Isthmus of Panama. There the Atlantic and Pacific coasts are only about 80 km (50 miles) apart. Cutting through the narrow isthmus is the Panama Canal. It was planned by the builder of the Suez Canal – Ferdinand de Lesseps. But it was built mainly by the Americans. And it is mainly under American control today. The canal makes it unnecessary for ships going from the east of the United States to the west to make the long journey around South America.



Ships passing through the Pedro Miguel locks on the Panama Canal, which has been opened to shipping continuously since 1914.

The West Indies

The West Indies form a long chain of islands across the eastern rim of the Caribbean Sea. Most of the islands are mountainous and of volcanic origin. They are situated in the path of the north-east trade winds, and they have a very pleasant and stable climate.

Throughout the region a summer rainy season is followed by a relatively dry winter. The mountainous islands receive considerably more rain than the few low-lying coral islands that also occur here. The wettest part of the islands have a thick growth of forest. Bananas and cocoa are cultivated there. Where conditions are drier, sugar cane, coffee and tobacco are common crops.

The islands of the West Indies fall into two groups, the Greater and Lesser Antilles. The Lesser Antilles are all British, French and Dutch colonies. The southernmost island of the group is Trinidad. It is the largest island of the southern West Indies and has a mixed population that numbers well over a million. The island's main products are oil and pitch; sugar and cocoa are important crops. Between Trinidad and Puerto Rico lie a string of small islands known as the Windward and Leeward Islands. They include Barbados, Martinique and Antigua.

Cuba, Jamaica, Puerto Rico and Hispaniola make up the Greater Antilles. Cuba, with an area of some 114,000 square kilometres (44,000 square miles) is the largest. It has a range of mountains, the Sierra Maestra, in the south. The rest of the island is low-lying and possesses a very fertile soil. Agriculture is the main activity. Cuba is one of the world's leading sugar exporters, and also produces excellent tobacco. It is rich in iron ore and has some copper deposits as well. Havana (La Habana), its bustling capital, has a population of over a million people. Puerto Rico is like a small version of Cuba. Its rich soils produce a wide range of crops most of which are consumed by its large population.

Jamaica, which lies south of Cuba, is a large island with a population of over two million. In the east the Blue Mountains rise some 1,800 metres (6,000 feet) high. On their wet, heavily forested slopes some of the world's best coffee is grown. Jamaica leads the world in the production of bauxite – aluminium ore. Its northern coast is the centre of a thriving tourist industry. Bananas and sugar cane are grown on a large scale.

The island of Hispaniola is divided into the two countries of Haiti and the Dominican Republic. Steep mountains and narrow valleys make communications very difficult on the island. They also create a range of climates that range from tropical wet to very dry. Coffee, sugar, bananas, tobacco and sisal (for making rope fibre) are the main exports. Both countries are very poor.

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NORTH AMERICA'S ECONOMY

A modern cowboy herding beef cattle on the vast open prairie-land of New Mexico.

Taken as a whole North America is the richest and most highly developed of the seven continents. It has vast mineral wealth and abundant energy resources. It has some of the world's most productive farmland, and produces more corn (maize) and wheat than any other continent. It is also foremost in the field of industry and commerce. American business methods are the envy of the world.

However, not all of the continent is that wealthy. Practically all the wealth is concentrated in Canada and the United States. Mexico and the countries of Central America and the West Indies are very poor in comparison. Their farming methods are in general primitive. Their industries are few.

Agriculture

The US and Canada have vast tracts of fertile farmland which produce a bewildering variety of crops. The main areas of cultivation are the interior plains, which stretch southwards in a wide belt from Arctic Canada to the semi-tropical Gulf of Mexico. In the north of the belt the natural conifer forests are exploited for their timber. Farther south, in the 'Prairie Provinces' of Canada – Manitoba, Saskatchewan and Alberta – and on the American prairies, wheat is the main crop.

In the mid-west of the US is the so-called *Corn Belt*, where maize (corn) is the main crop. The Corn Belt covers west Indiana, Illinois, Iowa, Missouri, east Nebraska and east Kansas.

South of the Corn Belt is a region where mixed crop and livestock farming are practised. This gives way in the south to a region where cotton is grown on large plantations. The southern and south-eastern states of the US are the traditional centres for cotton production. But in recent years the western states of Texas, New Mexico and California have surpassed the traditional cotton states in cotton production. The US leads the world in cotton production, as it does in the production of maize

The wheat harvest in Oklahoma, one of the leading farming states in the Union.

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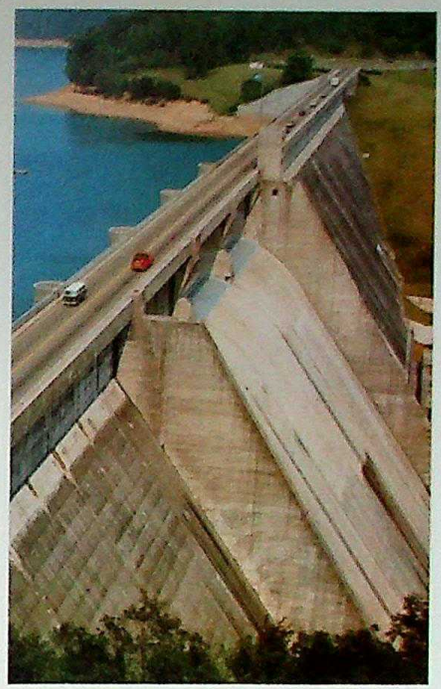
and tobacco. Tobacco growing is centred on the states of Virginia and the Carolinas in the east. Other crops which thrive in the sub-tropical south include rice in Louisiana and southern California and citrus fruits in Florida and southern California.

The chief feature of farming in the US and Canada is the widespread use of machines such as tractors and combine harvesters. Vast quantities of fertilizers are used to keep the soil fertile. Chemicals are sprayed on the crops to prevent disease, kill insect pests, and restrict weed growth.

Modern techniques are used to keep the millions of head of livestock in the US and Canada healthy and high yielding. The US has more cattle than any other country except India. The main dairy-farming areas in the US are in the north and north-east. In Canada they are in southern Ontario and Quebec. The higher Great Plains region in Canada and the US is the main cattle-ranching area. This is the home of the cowboy, the steer, and the open range. In the south-west the cattle ranches extend into the arid basins and plateaux of Colorado and Nevada. Pigs and sheep are also raised on a large scale in the US. The sheep are grazed on the prairies. The pigs are raised mainly on maize, and are thus produced in greatest numbers in the Corn Belt of the mid-west.

The farming methods of most of Mexico and Central America are still mainly traditional, and the yield from the land is generally low. The soil is cultivated and the crops sown and harvested largely by labourers using primitive tools. Among the commonest crops grown in Mexico are maize, wheat, beans, coffee, cotton, bananas and sugar cane.

Cotton, coffee, sugar cane, bananas and other tropical fruits are grown on large plantations in lowland Mexico, as they are in the countries of Central America. These crops form the major exports of Central American countries and the islands of the Caribbean. The smaller farmers in Central America often adopt the 'slash-and-burn' method of shifting cultivation, using the ground they clear to grow mainly subsistence crops like maize.



Dams have been built throughout the Tennessee Valley to control flooding and produce power.

Mineral Wealth

North America is very rich in mineral resources. One of the richest areas is the vast, horseshoe shaped region of the Canadian Shield. Around the shores of Lake Superior, for example, lie North America's greatest deposits of iron ore. In this region is one of the largest open-cast mines in the world. It is a large hole spreading over 600 hectares (1,500 acres). More than a thousand million tonnes of ore and overburden have been taken from it over the years.

The Sudbury Basin, north of Lake Huron in Ontario, is another major mining region. At Sudbury is a giant ore body some 60 km (37 miles) long and 32 km (20 miles) wide. It is the world's biggest single source of nickel and platinum. It also yields large amounts of copper, together with smaller amounts of cobalt, silver and gold. To the east of Sudbury, beyond the edge of the Canadian Shield, lie the St Lawrence Lowlands. The area around Thetford, south of Quebec city, has the world's most productive asbestos mines.

At the north-west end of the Canadian Shield are extensive deposits of pitchblende. This is the ore from which the rare radioactive minerals uranium and radium are obtained. The deposits lie around Great Bear Lake, in the North-West Territories.

Ringing the Gulf of Mexico in the south-east of the continent are great sedimentary rock systems rich in minerals. They contain many salt domes and sulphur beds, and also huge reservoirs of petroleum and natural gas. Rich beds of phosphates for the fertilizer industry are mined along the Florida coast. Many deposits of minerals are found in the lowlands and plains in the heart of the continent. The chief mainland source of bauxite (aluminium ore) is at Little Rock in Arkansas. But the continent's most productive bauxite mines are on the Caribbean island of Jamaica.

The mountains and high plateaux of the western mountain ranges are a treasure trove of minerals, second only to the Canadian Shield in importance. Butte, in Montana, is the centre of a vast copper-mining region. Rich copper deposits are also worked in Arizona, Utah and Nevada. Lead, zinc, mercury, tungsten, vanadium and other important metals are mined in many areas, from the high plateau of Mexico in the south to the Yukon in the far north. The Yukon is famed for its fabulous Klondike goldfields, which were the scene of the great 1898 'gold rush'. Little gold is mined there these days, however.

Fuel and Power

North America not only has very great mineral wealth, but also plentiful supplies of fuel and power. Vast deposits of fossil fuels occur in the great sedimentary basins of the east coast, the Gulf of Mexico and the interior lowlands.

One of the world's richest coal regions lies in the Appalachian chain. The Appalachian coal beds

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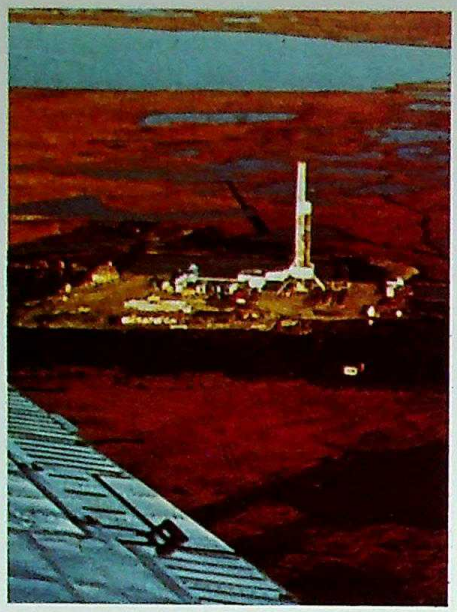
stretch from Alabama in the south to Nova Scotia and Cape Breton Island in the north. Particularly notable are the beds of anthracite, the best-quality coal, in east Pennsylvania. They are up to 15 metres (50 feet) thick, and have no equal in the world. The Appalachian deposits were laid down much earlier than those in the eastern and western interior fields farther inland. The Illinois field is one of the biggest of these.

Much of North America's oil and natural gas comes from the same rock formations that bear coal. The first well sunk in the United States was drilled in west Pennsylvania in 1859. A great rush followed to tap the Appalachian fields, and the American oil industry was born. The most productive oil fields in the United States at present are those in Texas, Oklahoma and Louisiana. California, Kansas and Arkansas also have vast oil deposits. The main oilfields of Texas and Louisiana lie close to the Gulf of Mexico. Not far away along the curve of the Gulf are the rich Mexican oilfields of Tampico.

Other oil zones are found along the east flanks of the Rocky Mountains, especially in Colorado and Alberta. Alberta became Canada's most important oil-producing region following a great strike at Leduc, south of Edmonton, in 1947. More recently great reserves of oil have been found in northern Alaska, beyond the Arctic Circle. In 1975 work started on the 1,300-km (800-mile) trans-Alaskan pipeline, which will transport the oil from freezing Prudhoe Bay in the north to the ice-free port of Valdez in the south.

Water power is a very important source of energy in North America. In Canada hydroelectric power stations produce nearly three-quarters of all the electricity. In the United States, they produce about one-fifth of the nation's electricity. The well-watered highlands of the Pacific coast, the Rockies, the Canadian Shield and the Appalachians provide suitable sites for hydroelectric power schemes. Rivers



An oil rig drilling on the tundra of Alaska, where vast deposits of oil have recently been found.

are usually dammed to provide a 'head' of water to feed the water turbines. The biggest hydroelectric plant in North America is that at the Grand Coulee dam. This blocks the Columbia River north of Spokane, in Washington State. The hydroelectric plant will soon produce nearly 10 million kilowatts of electricity. This would be enough to light an electric-light bulb in one room of every home in North America!

Nuclear energy is becoming more important in North America as the supply of fossil fuels begins to run short. This is especially true in the United States, where the people consume more fuel than anyone else in the world. In the United States at present nuclear power supplies only about one part in 50 of the nation's energy needs. About 50 nuclear power stations are already in operation, and another 60 or so are being built or planned. It is hoped that by 1985 some 250 plants will be working and producing nearly one-fifth of the nation's electric power.

Industry

The north-east is the main industrial region in North America. It surrounds the Great Lakes and extends east to the Atlantic coast. Milwaukee, Chicago, Detroit, Cleveland, Buffalo, Pittsburgh, Boston and New York in the US, and Toronto, Montreal and Quebec in Canada, are leading centres. Detroit is the home of the massive car industry, whose leading companies – General Motors, Ford and Chrysler – are among the world's biggest industrial corporations. Pittsburgh is the centre of the US steel industry, which produces a fifth of the world's steel. This vast industrial region grew up because of the ready availability of rich iron ore from the Lake Superior mines, and the abundant coal from the Appalachians.

The US leads the world in aircraft production, which is centred mainly in the west, for example, at Seattle. The textile industry has its main centres in the Carolinas and Georgia. Food-processing centres include Buffalo, Omaha and Kansas City. Other industrial centres are scattered throughout the US. The country's well-developed transport systems permit a rapid inflow of raw materials and outflow of finished products virtually everywhere.

North America has, in fact, the best developed transport system in the world. It has the world's largest inland-waterway system, including the Great Lakes/St Lawrence network and the lengthy Mississippi–Missouri system. In the far south is the invaluable Panama Canal.

North America's road networks are not bettered anywhere. The US, where there is more than one car to every three people, is spanned by the 66,000 km (41,000-mile) Interstate Highway System. This is an interlinking system of high-speed motor roads, designed to carry a fifth of all motor traffic in the country. Canada is now crossed from east to west by the 7,800-km (4,900-mile) Trans-Canada Highway. The Pan American Highway runs from Alaska, southwards through Canada and the US into Mexico and through Central America, to Panama. From Panama it will eventually link up with a road that continues through South America to Buenos Aires in Argentina. The final length of the road will be nearly 26,000 km (16,000 miles).

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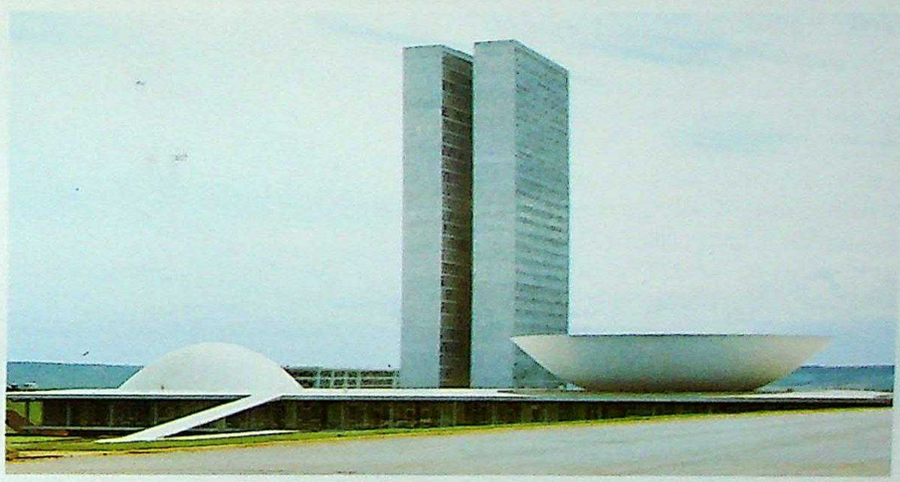
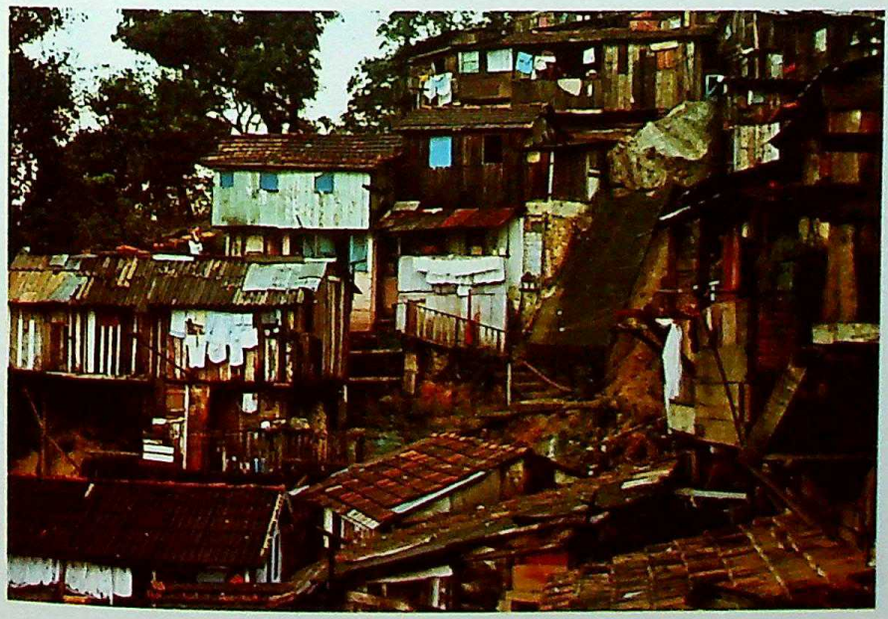
SOUTH AMERICA

INTRODUCTION

The great triangular landmass of South America trails southwards in a long horn that stretches towards the icy wastes of Antarctica. At the continent's southernmost tip lies the ill-named Tierra del Fuego ('Land of Fire'). It is a cold, rainy region lashed by howling gales of the 'Roaring Forties'. Nearly 8,000 km (5,000 miles) to the north is the Isthmus of Panama. This is the narrow land bridge linking North and South America. It is a region of low-lying, lush jungle and swamp. Between the two extremes is found the vast wilderness of the Amazon Basin, the world's largest expanse of forest. In the west is the lofty Andes Mountain chain, which runs the length of the continent like an enormous backbone.



South America now boasts many fine cities, such as Brazil's capital Brasilia (above). But often on the city outskirts are shabby shanty towns (below).



More than two-thirds of South America's 18,000,000 square kilometres (7,000,000 square miles) lies within the tropics. The continent also has a very short coastline relative to its size. The coastline is relatively smooth, except in the extreme south-west, where it is jagged.

South America lies far closer to the Old World than does North America. At its closest point, Cape São Roque in Brazil, it is a mere 2,400 km (1,500 miles) from Africa. South America also reaches farther south than any other continent except Antarctica. It reaches a latitude of 56° South, and comes within 1,100 km (700 miles) of the Antarctic mainland.

The people of South America number nearly 220 millions, and the population is expanding

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rapidly. In fact South America has one of the fastest-growing populations in the world. In the past South America has been a mainly agricultural continent. Recently, however, industry has been developing on a vast scale. Industrialization has resulted in a great shift in the population from the countryside to the cities. Today, more than 60 out of every 100 of the population live in urban centres, compared to about 40 out of 100 twenty-five years ago. Rio de Janeiro and São Paulo in Brazil and Buenos Aires in Argentina together have a population of some 20 million.

The Countries

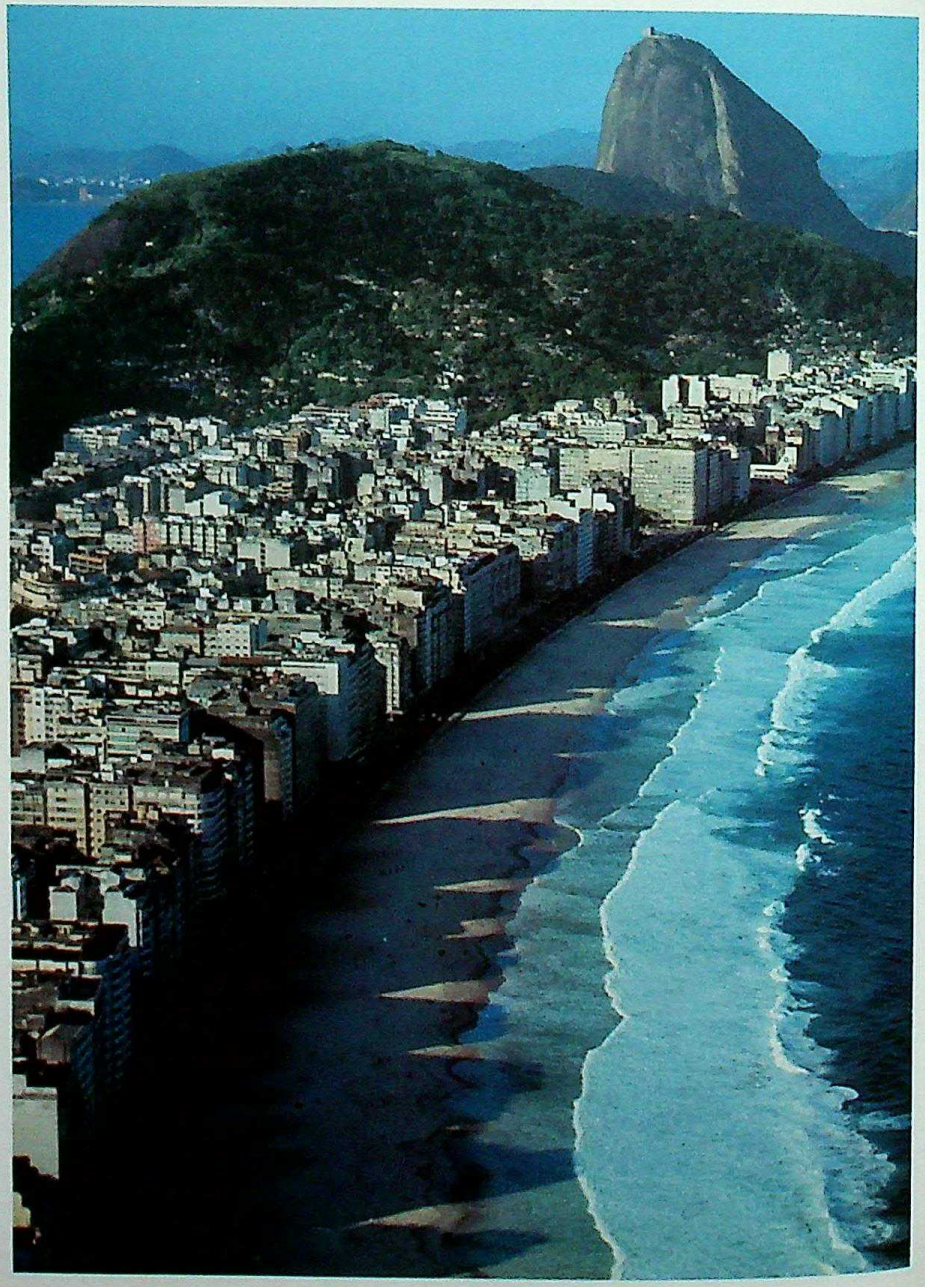
Largest of the countries that make up South America is Brazil, which covers almost half the continent. Next, in order of size, come Argentina, Peru, Colombia, Bolivia, Venezuela, Chile, Paraguay, Ecuador and Uruguay. In the north-east of the continent, between Venezuela and Brazil, are three small countries: Guyana, Surinam and French Guiana.

Guyana was formerly British Guiana, but is now independent. Surinam was formerly an overseas territory of the Netherlands. French Guiana is an overseas department of France. Two small island groups lie to the north-west and south-east of South America. One is the Galapagos Island group in the north-west, 1,000 km (600 miles) west of Ecuador. These islands belong to Ecuador and are noted for their unique wildlife. The south-east group is the Falkland Islands. They are about 500 km (300 miles) east of the tip of South America. They are a British colony.

Most South American countries show the influence of the Spanish and Portuguese, who first colonized them. South America forms the greater part of *Latin America*, where languages derived from Latin are spoken. Mexico and the Central American countries form the other part.

SOUTH AMERICA

Country	Area Sq. Km.	Population	Capital
Argentina	2,776,889	24,090,000	Buenos Aires
Bolivia	1,098,582	5,326,000	La Paz
Brazil	8,511,965	101,500,000	Brasília
Chile	741,760	10,250,000	Santiago
Colombia	1,138,914	23,840,000	Bogotá
Ecuador	283,560	6,950,000	Quito
French Guiana	90,000	54,000	Cayenne
Guyana	214,970	764,000	Georgetown
Paraguay	406,750	2,549,000	Asuncíon
Peru	1,285,216	14,880,000	Lima
Surinam	142,820	450,000	Paramaribo
Uruguay	186,925	2,962,000	Montevideo
Venezuela	912,050	11,370,000	Caracas



Copacabana beach in Rio de Janeiro. In the background is Sugar Loaf Mountain.

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THE PEOPLES OF SOUTH AMERICA

Early Inhabitants

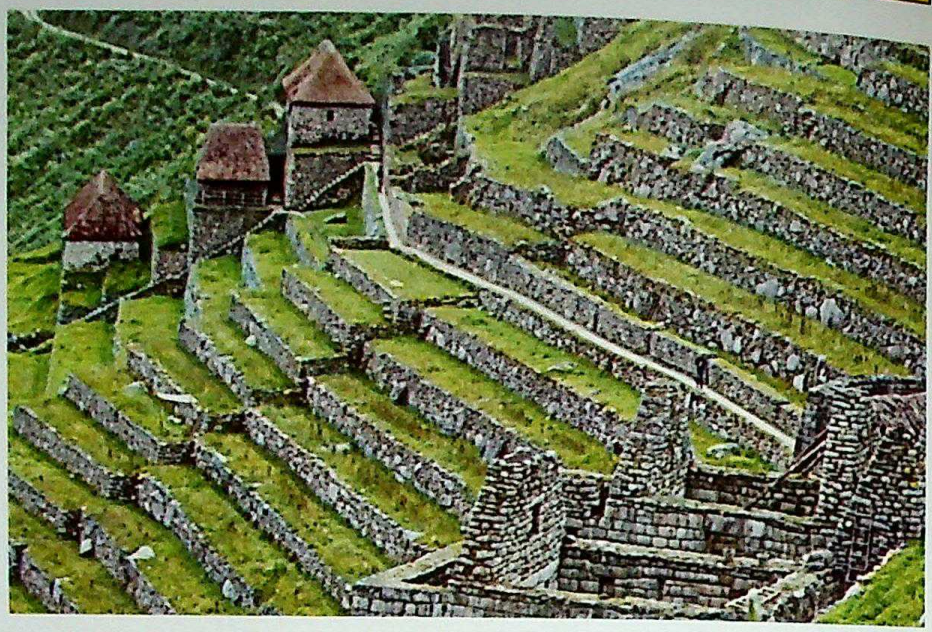
Europeans first became familiar with the continent of South America in 1498. In that year Christopher Columbus sailed from Spain through the narrow gulf between Trinidad and Venezuela during his third voyage of discovery. He came across the great flood of fresh water pouring into the sea from the mouth of the Orinoco. And he realized that this could only have come from a vast new continent.

Portuguese explorers followed on the heels of the Spanish. Fierce rivalry for plunder sprang up between these two countries. Within 50 years nearly the entire coastline had been explored and most of it claimed for Spain or Portugal.

Yet these two European nations were not the first people to go to South America. More than 25,000 years earlier, wandering tribes from Asia had crossed the great 'land bridge' that then spanned the Bering Strait. Gradually they migrated south from northern North America, fanning out across both continents. Archaeological evidence shows that they were well settled in South America at least 10,000 years ago. Some of the tribes scattered across the land and lived by hunting and gathering. Others lived deep in the dense Amazonian jungle, where they gathered food from the forest and maybe cleared small plots of land to grow a few root crops.

The Incas of Peru

Some of the tribes, who were called 'Indians' by the Europeans, built up great civilizations. By the time the first Europeans arrived, the Incas had established a flourishing military empire centred on the high plateaux of Peru. The Inca empire sprawled from Ecuador to central Chile. The empire was knit together by an excellent system of roads. Like the Romans before them in Europe, the Incas knew the value of good communications. The Incas were good farmers. They cut terraces in the hillsides to grow crops. They were skilled engineers and stone masons. They made pottery and textiles, and mined gold, copper and silver.



Sturdy stone terraces at the Inca city of Machu Picchu. The Incas were brilliant architects.

In 1532 the Spanish *conquistador* (conqueror) Francisco Pizarro and his small band of soldiers attacked the Incas, who were riven by civil war. After ransacking the Inca empire for gold and silver, Pizarro retreated to the coast, where he founded the new capital of Lima. The land itself was divided up among the Spaniards into great estates upon which Indian peasants were forced to work. This pattern of life still exists today in some areas of western South America.

On the heels of the conquistadors came the Spanish monks and priests. With the same fervour that the soldiers searched for gold, they converted the Indians to the Catholic faith.

Settlement Proceeds

On the other side of the continent, the Portuguese were busily establishing an empire in Brazil, based on commercial agriculture. Portuguese settlement was generally limited to a thin strip of territory along the coast. Most of their towns, including the capital, Rio de Janeiro, and

THE FLAGS OF SOUTH AMERICA

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plantations were clustered here. In time, settlers gradually penetrated into the Brazilian highlands. However, even today the interior of the country remains relatively empty, and parts are still unexplored.

The humid lowlands of the Brazilian coast were ideal for growing sugar. But the scattered Indian tribes of the region could not provide enough labour to work the sugar plantations. For this reason, a thriving traffic in slaves developed with the west coast of Africa.

South of the Portuguese, the Spaniards moved in to settle the vast empty plains, or *Pampas*, of Argentina. On the edge of the Pampas, where the Río de la Plata (River Plate) widens as it empties into the sea, they founded Buenos Aires (meaning 'Fair Winds'). Westward, across the high wall of the Andes, the long coast of Chile was also being surveyed. In the fertile countryside at the centre of the country the Spaniards founded the settlement of Santiago.

Large-Scale Colonization

After the initial brief period of exploration and conquest, the Spanish and Portuguese settled down to colonize their new empires. Plentiful land and the chance to start a new life attracted a steady flow of immigrants from the mother countries. They brought with them their European style of life. The immigrants introduced domestic animals such as sheep, cattle and horses, which were previously unknown in South America. Soon great herds of cattle and sheep were thriving on the rich grasslands. New crops such as wheat and barley were also introduced.

Most of the Spanish and Portuguese colonies became independent in the mid-1800s. Since then a wave of immigrants has poured into South America from all over the world. Most chose to settle in the great empty spaces of Brazil, Uruguay, Argentina and Chile. There they established farms and ranches, or *estancias*, that were to become the backbone of a thriving agricultural industry. Later non-European peoples flooded into South America. Large numbers of Japanese settled in eastern Brazil and in parts of Bolivia. Many Indians and Chinese went over to work on the plantations after the abolition of slavery.

This Bolivian Indian woman lives near Lake Titicaca in the high plateau region of the Andes.

Guiana

There was one small region in the north-east corner of South America that was never settled by either the Spanish or the Portuguese. This is the stretch of lowland between the Guiana Highlands and the sea, which we call today Guiana. It was choked with thick forest and covered in marshland. There was no reason for anyone to settle there. Ever since the 1600s, this area has been divided among the English, Dutch and French. Apart from being a 'toehold' in South America, these colonies had no great value.

It was the Dutch who made the first successful efforts to exploit their colony there. Benefiting from their knowledge of how to reclaim land from the sea, they managed to drain the lagoons and marshes. They used the rich soil to begin tobacco and sugar-cane farming.

The Population Today

The language, religion and many customs of the South American people are those of Spain and Portugal. But they have been changed in many ways, because of the influence of a large native population.

Today, the descendants of the original Indian peoples number some 30 million. Many still cling to their traditional ways of life and continue to speak their native tongues, even after 400 years of European domination. Most Indians are found in the more remote areas of the Amazon Basin, the Chaco region of Paraguay, and the area within the old borders of the Inca Empire.

The peoples of African descent are another group who contribute to the colourful mixture of races that make up South American society. They are concentrated in the regions of the north and east where they were originally settled as slaves on the great sugar plantations.

Generations of intermarriage and mixing between the many races have produced an endless variety of half-breed peoples. Half-breeds form the bulk of the population. The most common are the *Mestizos*, who are people of Spanish and Indian origin. *Mulattos* are those of African and Spanish origin. *Zambos* are descended from Indians and Africans.

The population of South America is very unevenly distributed. The great majority of people are clustered around the edge of the continent. Vast stretches of the interior remain an uninhabited wilderness. The Amazon and Orinoco basins and the Andean highlands are too inhospitable and remote to attract settlers in large numbers.

Farther to the south is the semi-desert of Patagonia. This is a cold, treeless plain where the climate is too harsh for all but the hardiest of settlers. Most South Americans have preferred to make their homes along the coasts and in the highlands of eastern Brazil, in the Pampas of Uruguay and Argentina, in the rich farmland of central Chile, and in the north-west region, which includes Peru, Ecuador and Colombia.

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THE CLIMATE

The climate of South America can vary enormously over short distances. It is possible to find everything from steaming jungle to sub-arctic tundra within a few kilometres of each other. This is due to the influence of altitude on climate.

Latitude, of course, is one of the most important influences. South America straddles the Equator, and has the greatest part of its landmass lying within the tropics. Much of the northern and eastern part of the continent is equatorial lowland. The climate here is hot and moist. The average temperature, about 27°C (80.6°F), changes very little throughout the year.

Away from the Equator are regions that have distinct wet and dry seasons. This kind of seasonal variation is found especially in the high plateau-land of Brazil and Venezuela. Here, summers are a time of plentiful rain and winters are marked by drought conditions. The vegetation in the highlands is savanna, a mixture of tall grasses, scrub and clusters of trees.

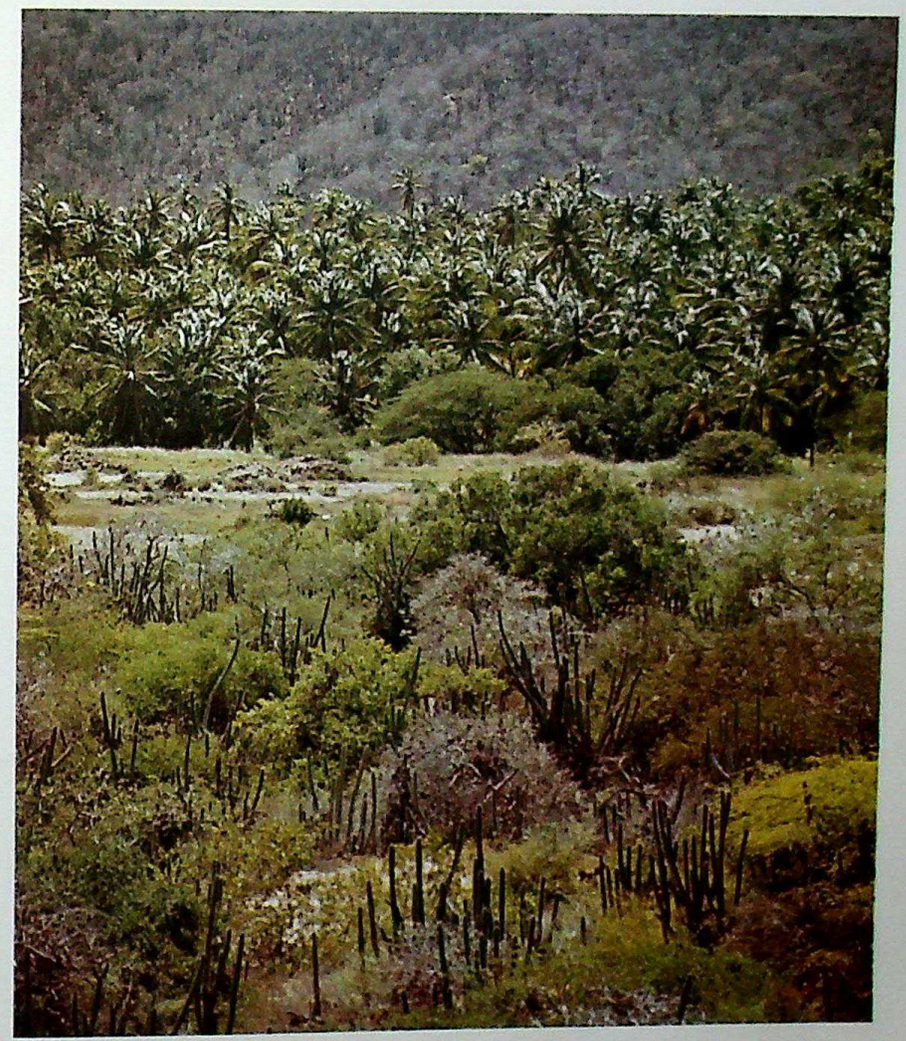
Farther south, the continent enters a temperate zone, where the climate is not too hot and not too cold. The land narrows, and the influence of the Atlantic and Pacific oceans becomes more apparent. The winters are mild, and the temperature in summer seldom rises very high.

Because of South America's elongated shape, ocean currents have a very important influence on its climate. Off the south-west coast, the cold Humboldt (Peru) Current flowing north from Antarctica cools the winds that blow across it. As they reach land, they warm up and thus do not shed any rain. The narrow Atacama Desert, parallel to the coast of northern Chile and Peru, lies directly in the path of these winds. It is one of the driest places on Earth. In some parts no rain has fallen for 400 years. By comparison, the warm equatorial current that sweeps along the north-east coast of South America warms those shores considerably. The trade winds blowing across it are full of moisture. This falls as rain across the entire Amazon Basin. Much of the Amazon Basin receives more than 2,000 mm (80 inches) of rain every year.

The extreme southern coast of Chile is swept by wind and rain throughout the year. In winter, however, the storms that blow in from the Pacific are especially severe. Yet all of the rainfall occurs in the west. The barrier of the Andes traps most of the rain on its windward slopes. The leeward slopes and the Patagonian plain to the east lie in the Andes' rain shadow. For this reason, the Patagonia is a temperate desert.

The Andes have a dramatic influence on the climate elsewhere. They act as a barrier to the moist trade winds that blow right across the equatorial lowlands of the north-west. As the winds hit the eastern slopes of the mountains, they rise and lose the last of their moisture. The high plateau-land of Bolivia and Peru is a cold, arid region.

A region near Cumana on the Caribbean coast of Venezuela. Tropical shrubs abound. But the presence of cacti indicates that the annual rainfall is relatively low.



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THE MOUNTAINS

Peruvian Indians high up in the northern Andes, where once the Incas ruled.

South America can be divided into four natural regions. They are the mountains, the river basins, the plains and the highlands. Each region has various features of geography, climate and vegetation that make it distinctive. We begin here with the mountains.

The Andes Mountains are one of the most spectacular features of South America. They form the longest mountain range in the world. A chain of peaks stretches in an uninterrupted wall from the Caribbean coast of Venezuela in the north to the tip of Cape Horn in the south. Along their 8,000-km (5,000-mile) length, the Andes are never much less than 300 km (190 miles) in width. In the north and south the Andes are relatively narrow. In the central section, however, they widen out to include a series of high plateaux.

The Andes are second only to the Himalayas in Asia in height. At their highest point, at Mt Aconcagua in Argentina, they soar to 6,960 metres (22,834 feet) above sea level. Several other peaks rise above 6,000 metres (19,700 feet). Geologically, the Andes are still a very young mountain range. They were uplifted only about 40 million years ago. Since then their rugged features have been attacked by the forces of erosion. Swift rivers have gouged steep valleys out of their flanks. In the far south, ice fields have chiselled and swept away great masses of rock.

Dotted throughout the Andes are volcanic mountains. Some of them, such as Cotopaxi in Ecuador, are still active. Cotopaxi (5,896 metres, 19,344 feet), is the highest active volcano in the world. As well as active volcanoes, the Andean region is noted for its earthquakes. They occur particularly in Chile and Peru. Volcanic and earthquake activity occur because the Andes lie on the edge of one of the moving blocks, or plates, which make up the Earth's crust (see page 58).

The Northern Andes

The northern end of the Andes range splits into three main branches. They all run parallel to each other and spread like stubby fingers through Colombia and Venezuela. There, the mountains are interspersed with narrow river valleys, such as the Cauca and the Magdalena. These fertile valleys merge into the equatorial lowlands.

Climbing from the valley floor tropical vegetation clusters thickly on the slopes up to about 900 metres (3,000 feet). This hot zone is called the *tierra caliente* ('hot land'). Beyond the hot zone, and up to about 2,000 metres (6,500 feet) lies a temperate zone (*tierra templada*). Above it is a cold zone (*tierra fria*) up to 3,000 metres (10,000 feet). Higher than this, the mountains rise above the tree-line and into the *paramos*, or tundra-like region. The narrow valleys are the most densely populated part of north-west South America. In the pleasant climate of the tierra templada are the great coffee plantations so vital to Colombia's economy.

The Altiplano and the Southern Andes

Moving southwards, the Andes converge into a single range of peaks and then splay apart into two sets of ridges. These ridges enclose the high plateau of Ecuador. A similar pattern is repeated

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several times before the broad *Altiplano* begins in southern Peru. The Altiplano ('high plain') is the high plateau region of the Andes. It extends through Bolivia into Argentina. In Bolivia the Andes are at their widest – over 600 km (370 miles).

The Altiplano averages about 3,700 metres (12,000 feet) in height. It is cold, dry and windswept. The stony soil supports a thin cover of scrub and mountain grasses, and occasional trees, such as pepper trees. The highest large lake in the world lies in the Altiplano. It is Lake Titicaca, on the border of Peru and Bolivia, which lies at 3,812 metres (12,505 feet).

South into Chile, the Andes again group themselves into a narrow chain. The main peaks are separated from a smaller coastal range by a narrow ribbon of valley. The climate here is cool and temperate. Rainfall is brought in by the westerly winds, and is heavy all year round. The lower slopes of the mountains are thickly forested right down to the sea. The so-called Chilean pines which grow here are an important source of timber. In Tierra del Fuego in the extreme south, the cold and fierce winds are too harsh for pine forests and here the tundra-type of vegetation exists.

Reed boats on Lake Titicaca, the highest major lake in the world, 177 km long and 74 km wide.

Snow covers the upper slopes of Cotopaxi, the world's highest active volcano (5,896 m).

Life in the Andes

The environment of the Andes makes great demands on all the creatures who live there. Many of the animals have become quite specialized in the way they lead their lives. The few lakes of the high plateaux of Bolivia and Peru, for example, tend to be quite salty. Yet brine shrimps that can withstand the cold and salt thrive in these lakes. At one such lake is found the very rare James's flamingo, which feeds on brine shimps. A breed of flightless grebe is also found in the high land around Lake Titicaca.

The upper slopes of the Andes support a variety of mammals. The chinchilla, a small soft furry rodent, lives as high as 6,000 metres (20,000 feet). The vicuna and guanaco also range through the high valleys of the central and southern Andes. They are small humpless members of the camel family, which have fine woolly fleeces.

The harsh setting of the mountains seems like the last place that men would settle. Yet Indians have made their homes there for hundreds of years. The Incas built a great civilization in this part of the world, and successfully grew corn, potatoes, peppers and beans.

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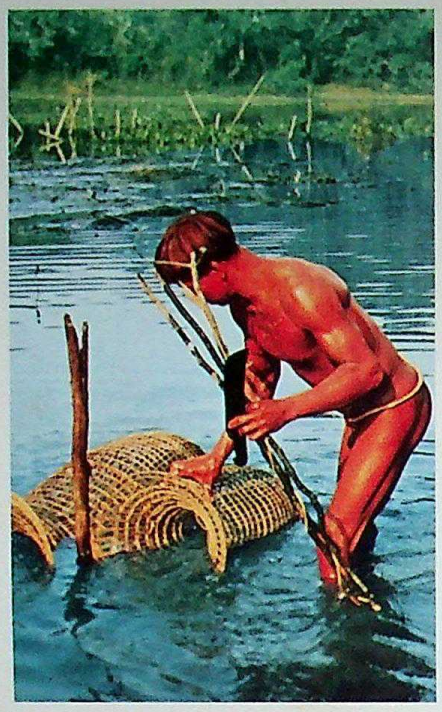
THE RIVER BASINS

The Amazon System

With a length of nearly 6,300 km (3,900 miles), the Amazon is not the longest river in the world – the Nile in Africa is slightly longer. But with its 15,000 tributaries it forms by far the world's largest river system.

It drains a region of dense tropical rain forest, highlands and mountain foothills that covers some 7,000,000 square kilometres (over 2,700,000 square miles). This is the largest drainage basin in the world.

From the Amazon's mouth over 15,000 million litres (3,300 million gallons) pour into the Atlantic every minute. This is more than a tenth of all the river-water in the world. The silt-brown water of the Amazon surges up to 300 km (190 miles) out to sea. At its mouth, the Amazon is about 300 km (190 miles) wide. It looks more like a sea than a river. One of the islands in its estuary is the size of Switzerland.



The mighty Amazon river (below) flows through dense tropical rain forest that is almost impenetrable. Primitive Indians (above) live in some areas.

One of the sources of the Amazon is a glacier 4,900 metres (16,000 feet) up in the Peruvian Andes. The river begins its journey across the continent as countless mountain streams, tumbling and plunging down the slopes until they leave the Andes through deep gorges. It weaves its way through the rain forests to the port of Iquitos. Boats drawing 4.3 metres (14 feet) of water can navigate the entire 3,700 km (2,300 miles) journey from the Amazon's mouth to Iquitos without difficulty.

As it continues towards the sea, the Amazon is continuously fed by hundreds of streams and rivers, some of which are great river systems in their own right. The Río Negro, for example, flows out of the highlands of Venezuela and Colombia for more than 1,500 km (900 miles) before joining the Amazon at Manaus. A host of other great rivers flow into the Amazon. They drain the

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Brazilian Highlands and the eastern slopes of the Andes in Bolivia, Peru, Ecuador and Colombia. Many of these tributaries are barred by rapids where they rush down from the highlands.

Ocean liners drawing less than 6 metres (20 feet) of water can sail upstream to Manaus. This town is some 1,600 km (1,000 miles) from the coast, and is one of the farthest inland ports in the world.

The huge volume of water that issues from the Amazon is fed by the heavy rain that falls in the wet equatorial climate of its drainage area. The trade winds blow into the Amazon region from the Atlantic Ocean. They carry their warm, moist air all the way to the 'wall' of the Andes. They dump up to 2,000 mm (80 inches) of water over the region every year. At the wettest times the river spills into the surrounding floodplain. The regularly flooded lowlands are known as the *campos de varzea*.

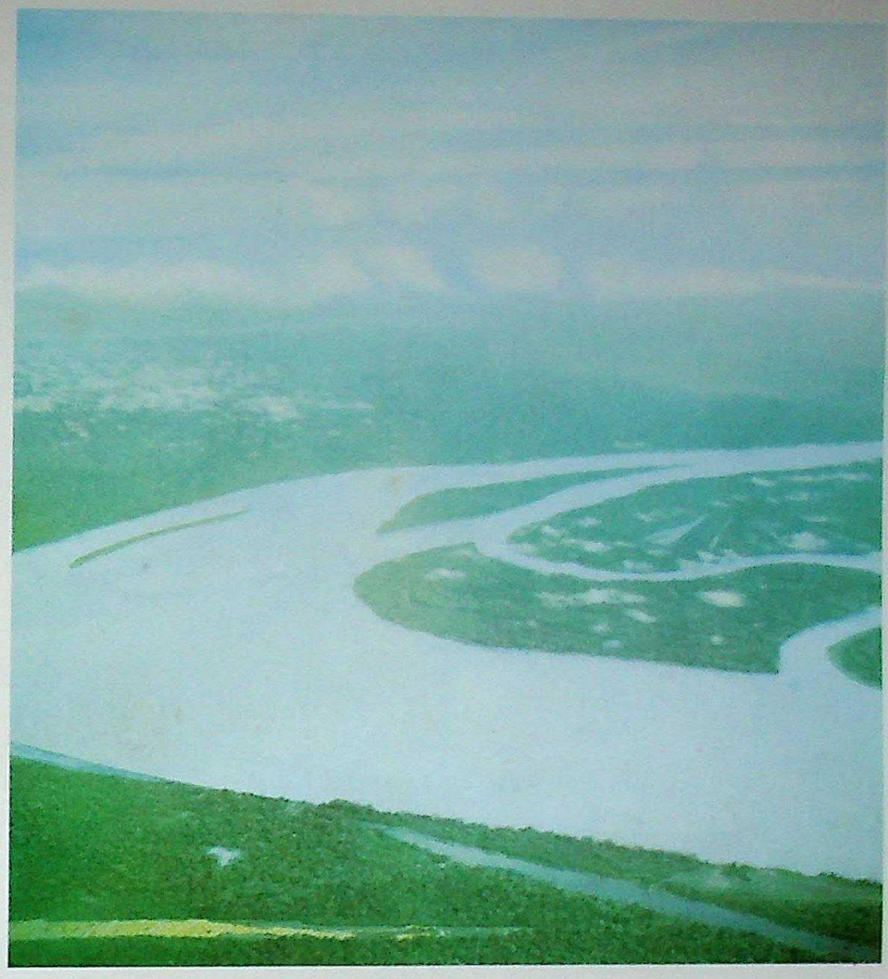
Life in the Amazon Basin

The tropical rain forest of the Amazon, or *selvas*, contains an abundance of life. From the air, the jungle looks like an endless green carpet. The 'carpet' is formed by the leafy canopy of tall trees thrusting up into the sunlight. The jungle is the home of thousands of different kinds of plants and animals. A single square kilometre of forest may contain as many as 800 different kinds of trees alone (about 300 per square mile).

The dark floor of the jungle is surprisingly clear. There is no thick tangle of dead vegetation since everything decays rapidly. Most creatures make their homes in the canopy layer between 12 and 40 metres (40 and 130 feet) above. A rich variety of birds, insects, monkeys and snakes live there. Exotic orchids and other colourful air plants (or *epiphytes*) grow on the trunks of the trees.

The Amazon Basin is very sparsely inhabited. There are few roads, and so rivers and streams have become the highways of the Indian tribes who live here. Most Indians live by hunting, fishing and gathering. Some, however, practise a kind of shifting agriculture known as 'slash and burn'. A plot of forest is cut down and the trees cleared away by burning. For the next two or three years, the land is planted with crops until it becomes too infertile or infested with weeds to be of further use. Then the tribe moves elsewhere to carve out a new plot in the jungle.

The Amazon region remained one of the least explored parts of South America until the turn of the century. A rising demand for rubber at the time sparked off a 'rubber boom'. And Manaus and Belém became the centres for the feverish activity that gripped the region, where the rubber tree grows wild. When the boom collapsed in 1910, the development of the Amazon ground to a halt. Only in the past few years have efforts again been made to open up the region.



The Orinoco river rises in the Sierra Parima, in the Guiana Highlands, and flows in a great arc through Venezuela to meet the Atlantic Ocean in a wide delta. The drainage basin of the Orinoco covers nearly 1,000,000 sq km.

The Orinoco and Paraná–La Plata

Compared to the Amazon, other river systems in South America seem puny. Yet there are two other large river systems, the Orinoco and the Paraná–La Plata, which are of major importance to central South America. The 2,400-km (1,500-mile) long Orinoco drains the lowlands between the northern Andes, the Guiana Highlands and the Atlantic Ocean. Annual summer rains swell the river enormously, and it floods great stretches of its low-lying plain every year.

The drainage basin emptying into the Atlantic as the Río de la Plata takes in northern Argentina, Paraguay, Uruguay, Bolivia and the south-east parts of Brazil. Upstream of the broad estuary of La Plata it contains two main rivers: the Paraná and the Uruguay, together with their many tributaries.

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THE PLAINS

The great plains of South America form an unbroken swathe of low flatland stretching from the southern borders of Bolivia and Brazil nearly to the tip of the continent. On the west they emerge from the foothills of the Andes and slope gently eastwards towards the coast.

The plains can be divided into three distinct regions. To the north lies the Gran Chaco, which means 'big hunting ground'. This gives way in the South to the Pampas, which rise slightly to form the Patagonian plain or plateau.

The Chaco

The Gran Chaco is a vast hot plain. It is forested to the east but merges into thorn and scrub in the west, where little rain falls. Savanna and areas of marshy ground occur throughout its eastern part. The Gran Chaco takes in the border country of northern Argentina, Paraguay and south-east Bolivia. This 300-km (190-mile) wide plain slopes gently from a height of some 300 metres (1,000 feet) at the base of the Andes foothills, to about 45 metres (150 feet) on the banks of the Paraguay River. In area, the Gran Chaco covers about 520,000 square kilometres (200,000 square miles).

Above: The Gran Chaco, with llamas grazing.
Below: An Argentinian gaucho, the cowboy of the Pampas.

The surface of the Gran Chaco consists of a mixture of sand, pebbles and stones washed down from the Andes. It is a poorly drained region. The annual summer rains transform it into a waterlogged marsh, dotted with shallow lakes. The few streams that flow through the Gran Chaco become choked with sediment

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and often change their course. In the dry season they are reduced to a trickle and sometimes dry up completely.

The east of the Gran Chaco receives the most rainfall. It is covered by a vegetation of quebracho forest and savanna. Red quebracho is the tree from which tannin is taken. This substance is used in the tanning of animal hides. The only economic activity of any real importance in the region is lumbering in the quebracho forests.

The Gran Chaco suffers the extremes of a typical continental climate. Its searing summer temperatures are the highest on the continent. In winter it has severe frosts. The remoteness of the Gran Chaco and its unhealthy climate have kept it sparsely settled and underdeveloped. The few people who have moved into its north-east part have concentrated on cattle ranching and raising cotton.

The Pampas

South and east of the Gran Chaco lie the fertile Pampas, which form one of the great grain-producing regions of the world. They extend over 650,000 square kilometres (250,000 square miles) in a wide arc around the city of Buenos Aires. The Pampas are the centre of practically all the economic activity of the south-east of South America. Agriculture, industry and trade make this one of the most important regions on the continent.

The Pampas never rise more than 150 metres (500 feet) above sea level. Their deep, well-drained soil is a fertile mixture of fine silt, clay and dust. The Pampas are well watered all the year round and, in their natural state, support a thick covering of grass. At the borders of the pampas, less rain falls. The grassland merges slowly into scrub. The climate of the Pampas is less extreme than that of the Gran Chaco. It is less hot in summer and has few severe frosts in winter.

The only rivers of the Pampas are the Paraná and the Uruguay. An extensive network of roads and railways criss-crosses the plain and provides easy access to all parts.

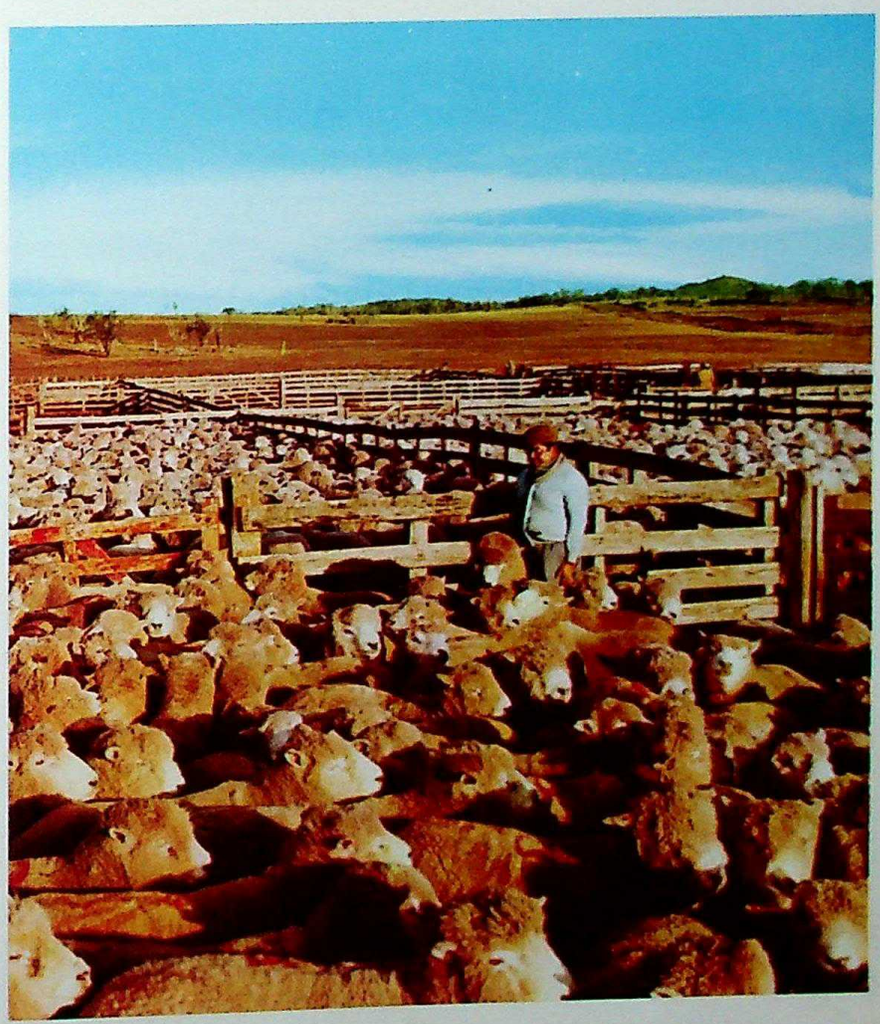
The Pampas produce a rich harvest of wheat, corn and flax. Cattle ranching and dairy farming are also very important. A third of all the cultivated land of the Pampas is given over to alfalfa (lucerne) to feed the cattle. The quality of beef produced is high. Along the drier, outer edges of the Pampas, sheep are raised in large numbers.

In Uruguay the grasslands merge into parklands scattered with trees. An average rainfall of some 1,000 mm (40 inches) a year ensures that the pasture is rich. Sheep and cattle graze over most of this area.

Patagonia

Patagonia is the southernmost part of the South American plains. It stretches for more than 1,600 km (1,000 miles) from the east–west line of the Río Colorado to Tierra del Fuego. It forms a great plateau averaging about 600 metres (2,000 feet) in height which slopes gradually down from the edge of the Andes towards the coast. The Patagonian plateau is flat and very barren. Coarse shingle and sand and scattered clusters of bunch grass cover its surface.

Except at the foot of the Andes, rainfall in Patagonia is scanty – less than 250 mm (10 inches) a year. The rain that does come arrives across the Andes from the Pacific. Though dry, the climate is temperate and ideal for sheep grazing. This is the main activity in Patagonia. In parts of the extreme south, sheep outnumber people by 400 to 1. The few small settlements that have been established in Patagonia are found either on the coast or on the banks of one of the few rivers that cross the plain.



Large flocks of sheep are raised on the drier outer margins of the Pampas, where the pasture is too scant for cattle to thrive.

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THE HIGHLANDS

The highlands of Brazil and Guiana are the remnants of ancient mountain ranges. Over hundreds of millions of years the mountains have been worn down by erosion. What remain today are the hard crystalline rocks that were once the heart of a great mountain system.

The Guiana Highlands

The Guiana highlands range on average from about 300 to 900 metres (1,000–3,000 feet) in height. They rise abruptly from the Amazon Basin in the south and slope gently in the north to the banks of the Orinoco River.

Above the general level of the plateau rise many steep-sided and flat-topped blocks of rock called *mesas* ('tables'). Highest of these is Mt Roraima (2,810 metres, 9,220 feet). A mere 200 km (125 miles) away is the famous waterfall, Angel Falls. At 979 metres (3,212 feet) it is the highest waterfall in the world.

The western highlands of Venezuela form a region of savanna and grassland. This could be an ideal place for grazing cattle, but it is still too remote for anyone to venture there. On the eastern side of the highlands, dense tropical rain forests cover the land. Valuable timber abounds. In places good grazing land also exists. Again, the region remains empty because it is still not very accessible. The Guiana Highlands are also a source of great mineral wealth. Gold and diamonds were once mined there. But today iron ore and bauxite are far more important.

The great granite block of Mt Roraima (2,810 m) towers above the tropical rain forest in the Guiana Highlands.

The Brazilian Highlands

The massive Brazilian Highlands share many common features with those of Guiana. They rise as a steep ridge from the coastal lowlands of eastern Brazil to a maximum height of nearly 1,500 metres (5,000 feet). Then they level off before sloping gradually down towards the Amazon Basin in the west. In places the ancient rocks of the plateau have been deeply scarred by the erosion of rivers. Other parts, especially the centre and north, form flat tablelands stretching for miles.

Unlike the Guiana Highlands, those of Brazil are the most populated part of the nation. They are a great source of minerals, including gold, manganese and diamonds. Some of the richest deposits of iron ore in the world are located here. Fertile volcanic soil and a pleasant climate make the Brazil Highlands ideal for farming. Coffee, corn, tobacco, sugar and cotton are among the main crops raised here.

The height of both plateau regions makes them less humid than the surrounding lowlands. As a result, their vegetation is a typical savanna mix of grass and trees. It is known as *llanos* in Guiana and *campos* in Brazil. Both areas receive their heaviest rainfall during the summer months. Where rain is scantier in parts of the north-east, a thorny, cactus-like vegetation known as *caatingas* replaces the grasses and trees of the savanna.

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SOUTH AMERICA'S ECONOMY

The economy of South America has always been based on the production of primary products, or raw materials. And South American countries still devote most of their energy to producing foodstuffs and raw materials. Most are shipped abroad to other countries. But increasing amounts are being used by the industries that are growing up in South America.

These farmers in Bolivia raise Santa Gertrudis cattle, which do well in the subtropical climate.

Minerals

South America has considerable mineral wealth. Indeed, one of the first activities of the early Spanish settlers was to mine silver throughout the Andean region. Most of the mineral riches of the continent lie either in the Andes or the highlands of Guiana and Brazil.

In the Chilean Andes, for example, in the arid north of the country huge copper mines make it the second greatest producer in the world after the United States. It has reserves of about 50 million tonnes – enough to guarantee production for nearly 70 years. Nearby are found large deposits of sodium nitrate, known as *Chile saltpetre*. They are the only deposits of any great size in the world. Farther north, in Bolivia and Peru, are important deposits of tungsten, vanadium, lead, zinc, tin and silver. Gold is found in most parts of the continent. But it is only mined in appreciable amounts in Colombia.

The highland plateaux of Guiana and Brazil also contain rich mineral deposits. Bauxite, the chief ore of aluminium, occurs in huge quantities there. The Guiana Highlands accounts for more than a third of the world's bauxite production. Brazil has recently begun to exploit its huge bauxite reserves. Massive high-grade deposits of iron ore have also been found in the highland regions.

Fuel and Power

Petroleum and natural gas are plentiful in South America. But only Colombia has large stocks of coal. Other countries either lack it or only have meagre supplies of a poor quality. This created a considerable hurdle to industrial development in the past. Fortunately, the discovery of ample supplies of petroleum and natural gas have to a great extent made up for the coal shortage.

Venezuela dominates the production of petroleum in South America. The vast oil fields under Lake Maracaibo account for four-fifths of the continent's total output. Petroleum makes Venezuela the richest nation in Latin America, particularly since the massive increases in petroleum prices in recent years. After Venezuela, Argentina is the largest producer.

The Andes and highland plateaux of South America are ideally suited to the production of hydroelectric power. But so far relatively little has been harnessed. Brazil has taken the lead in building hydroelectric plants. One of its largest schemes is at the Urubupungá Dam on the Paraná River. Altogether Brazil produces nearly a half of the continent's hydroelectric power.

Agriculture

Much of South America is unsuitable for farming. The Andes are mostly far too steep and have very poor soil. A great belt of sparse rainfall makes Patagonia and parts of Chile too dry to grow crops. The Amazon Basin is for the most part unsuitable because it is covered with selvas – the impenetrable rain forest. The soil of the jungle has been drained of its nutrients by the daily rains and the growth of lush vegetation. And even if this were not the case, it could never support crops very successfully.

For reasons such as these, most large-scale farming is carried on in the coastal lowlands and the open, well-watered plains.

The Indians of South America have always practised primitive forms of subsistence farming. They cleared the land by the simple method of 'slash and burn'. Then they tilled the soil by hand using simple wooden ploughs and hoes. They raised crops such as corn, beans, potatoes, manioc, and a few kinds of vegetables. This very inefficient form of agriculture still continues today throughout much of the interior.

Commercial cultivation on large plantations, or *estancias*, has been practised in South America for hundreds of years. In the early days the plantations were

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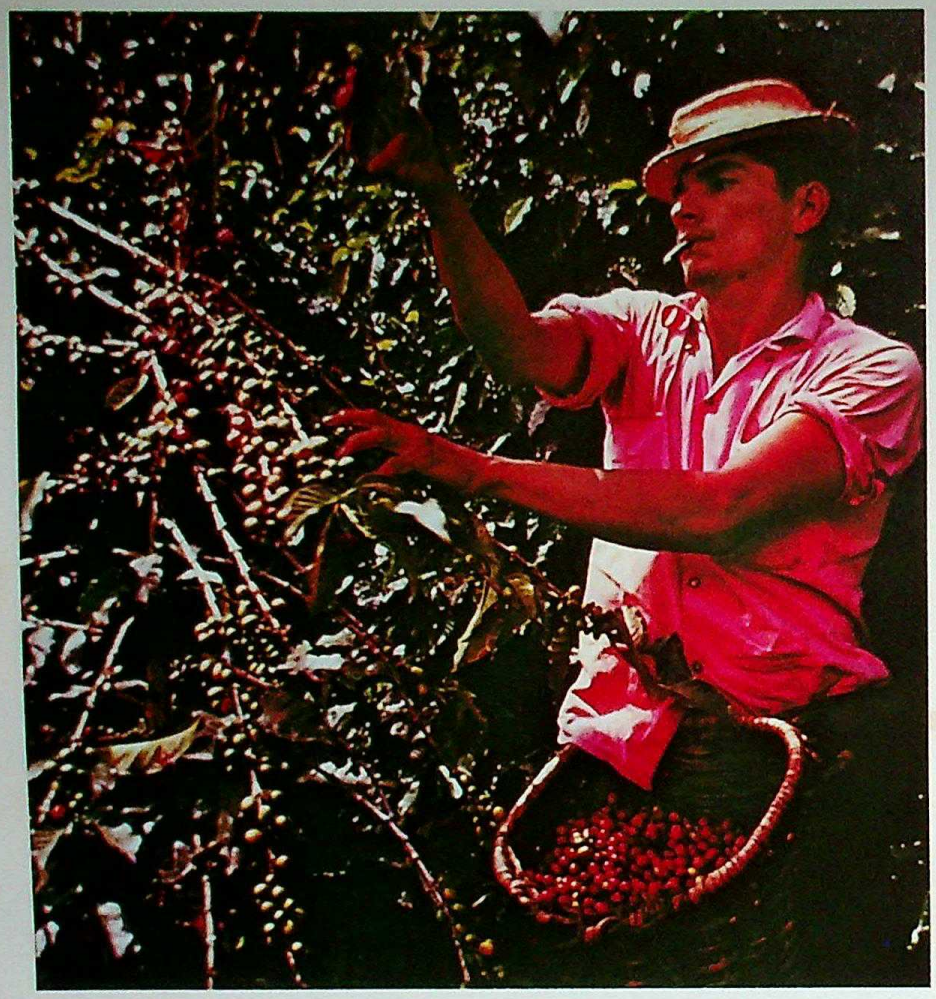

Picking coffee in Colombia, the largest coffee producer in the world after Brazil.

run by imported African slaves since there were not enough local Indians to do the work. Plantations were established for the large-scale production of tropical crops. Each estate concentrated on a single crop such as bananas, coffee, sugar cane, tobacco or cotton.

In the temperate parts of the continent, large-scale commercial farming has grown up only in the past hundred years. The Pampas of Argentina and Uruguay have become one of the great farming regions of the world. Here are produced huge amounts of wheat, corn and flax. In the temperate Mediterranean region of central Chile fruit farming is a major activity.

Cattle ranching, and on a smaller scale dairy farming, have always been of great importance in South America. From the time of the first settlements, the horses, cattle and sheep that were brought from Europe thrived on the rich pasture of the plains. Great herds of stock still roam the savannas and plateaux of Venezuela, Brazil, Uruguay and Argentina. In general cattle are raised in tropical regions. Sheep are mostly raised in the cooler highlands and temperate parts of the south. There they can thrive on the sparse vegetation far better than can cattle. Some sheep ranches in Patagonia cover an area of 40,000 square kilometres (16,000 square miles). This is not far short of the area of Denmark!

The stock-raising industry is of great economic importance in South America. Each year, thousands of tonnes of beef, mutton and lamb are shipped from there to all parts of the world. Argentina in particular relies on meat exports. Tanned hides and wool are important exports too.

Industry

Throughout its history, South America has been a producer of raw materials. Most of its trade with the rest of the world was in food products such as coffee, grain, meat and sugar; minerals, and natural materials like timber and rubber. Many South American countries were dependent on a single major export. For years Brazil was known for its coffee, Ecuador for its bananas, and Chile for its copper. Within Latin America itself, there was little manufacturing. As a result, the continent always depended on the manufactured products of North America and Europe.

Over the past 30 years, however, South America has been developing its industries in a big way. The continent really has practically everything it needs to support an industrial society. It has plentiful supplies of minerals, electricity, and oil and natural gas, for use as fuels and as chemical raw materials. Engineers, scientists and skilled workers of every kind are being trained in growing numbers.

Already Brazil, Argentina and Chile have come a long way in developing a modern economy. Many heavy industries have been established. They include oil refineries and smelting plants for processing iron, copper and bauxite ores. Steel mills have been built to produce finished metal products. Brazil's steel plant in the Paraíba valley is the largest in South America. It lies in the most highly developed industrial region of the continent, in a triangle formed by the cities of Belo Horizonte, São Paulo and Rio de Janeiro.

Chile and Peru have giant fertilizer industries to process nitrates and fishmeal. Chile, in fact, is one of South America's leading manufacturing countries. It has huge steel plants near Concepción. Other main industrial centres are located near Santiago and Valparaiso.

Light industries have also been growing in most parts of South America. They make use of locally grown plant and animal materials to manufacture textiles, leather goods, timber products and a wide range of consumer items. Other industries process agricultural produce like meat and wool.

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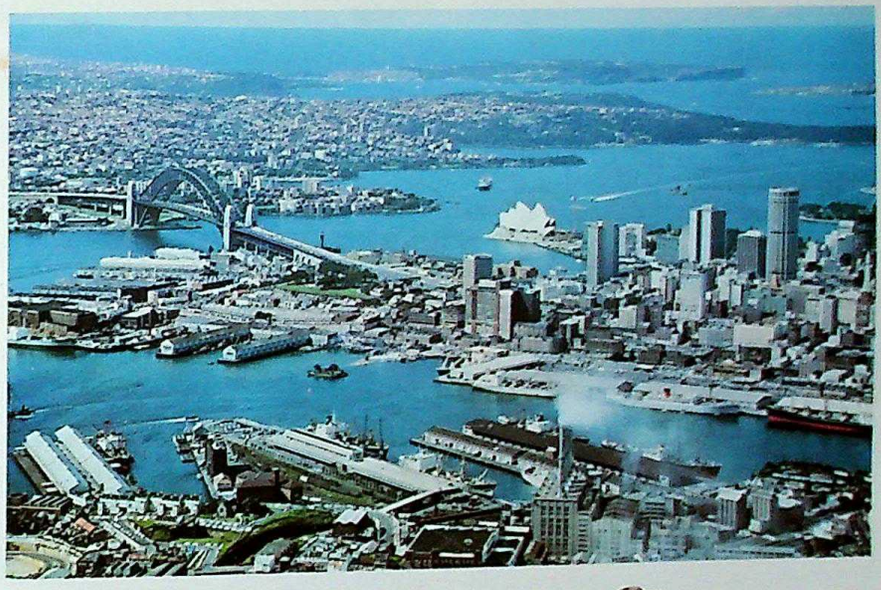
OCEANIA

Oceania includes Australia, New Zealand and many Pacific Ocean islands. The Pacific islands fall into three main groups: Melanesia, Micronesia and Polynesia. Japan, Taiwan and the Philippines are regarded as part of Asia, not Oceania.

AUSTRALIA

By far the largest country in Oceania is Australia. It is the sixth largest country in the world and it is often considered to be a continent in itself. But Australia is very thinly populated. It has less than two people to every square kilometre (4.4 people per square mile). Australia has about the same population as The Netherlands, but it is nearly 200 times larger than that country. Australia is divided into six states (New South Wales, Queensland, South Australia, Tasmania, Victoria and Western Australia). It also includes the large, thinly-populated Northern Territory and the small Australian Capital Territory centred on the federal capital, Canberra.

Much of Australia's interior is dry desert. Farming is carried on where water is available and farm products are extremely important in the country's economy. Most farms are highly mechanized and employ only a few people. Less than 10 out of every 100 Australians work on farms. Most people live in cities. Out of every 100 Australians, 55 live in only four cities, which are in the south-east. These cities are Sydney (population 2,874,000), Melbourne (2,584,000), Brisbane (911,000) and Adelaide (868,000). Other large urban centres are Perth, in south-western Australia; Newcastle and Wollongong, two industrial centres near Sydney; Canberra, Australia's capital, and Hobart in Tasmania. Most people in Australia are of European origin. There are also about 106,000 Aborigines, but many of them are of mixed blood.



Above: Sydney, Australia's largest and oldest city.
Right: An Aborigine painting a kangaroo on eucalyptus bark.

Early Inhabitants of Australia

Experts believe that the first people in Australia may have been the Tasmanian Aborigines, who are now extinct. About 2,000 of these brown-skinned, woolly-haired people were living in Tasmania in the late 1700s. They were hunters and gatherers who used stone and wooden tools. They were treated brutally by the Europeans, and many died of

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European illnesses. By 1876 the whole race had been wiped out.

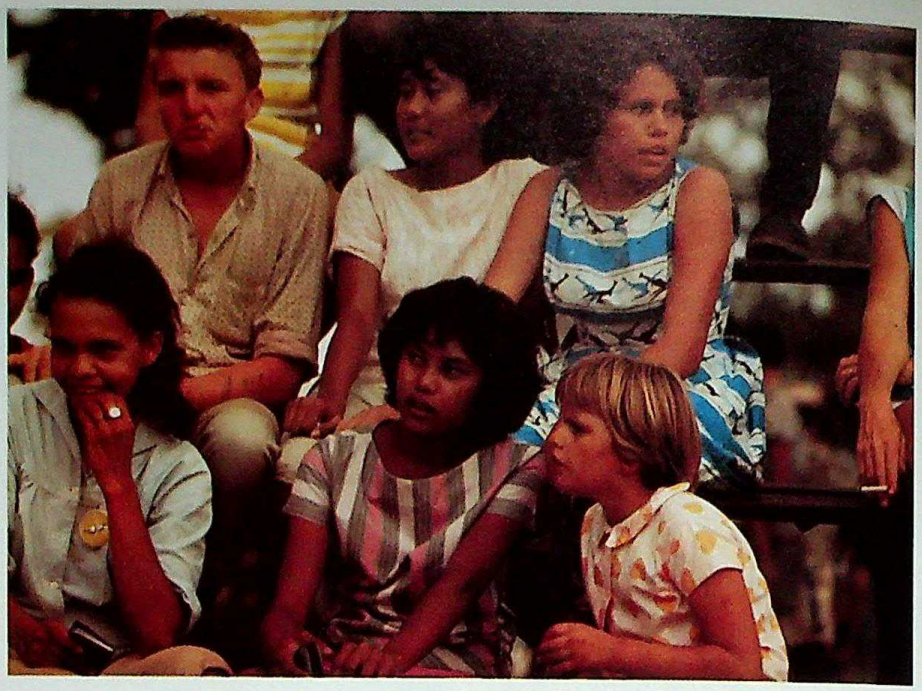
The Tasmanian Aborigines may have been driven into Tasmania by the Australian Aborigines, who probably settled in Australia more than 16,000 years ago. The Australian Aborigines, who have chocolate-brown skins and curly or wavy hair, came from somewhere in south-east Asia.

In the late 1700s the Australian Aborigines numbered about 300,000. They were divided into about 550 tribes. Each tribe consisted of several *bands*, containing between 30 and 60 people. These small bands lived by gathering food. The women and girls collected insects and plants. The men and boys hunted animals or caught fish. One of their hunting weapons was the *boomerang*, a curved throwing stick. Some of these were designed to return to its owner if they missed the target.

In dry areas the Aborigines were always on the move in search of food and water. They could survive in places where most people would die of hunger and thirst. They could track animals over long distances and recognize signs that water was near. They also knew those plants which absorbed water.

The Aborigines had their own religion, literature and art. They believed that everything around them was caused by marvellous happenings in a period long ago called *Dreamtime*. Because they thought that Dreamtime still existed, it was their link with the past. Many of their myths tell of heroic acts performed by ancestors in Dreamtime. Their cave paintings often depicted great heroes.

With the coming of the Europeans, the way of life of the Aborigines began to change. Their numbers were reduced. Some died in battles with Europeans and others of European diseases, to which they had no resistance. As European settlement increased, the Aborigines lost their hunting grounds. Today most Aborigines live in special areas called *reserves*. Few of them now follow the old way of life. Some work on cattle and sheep stations. Others live in the cities.



The Australian population is made up of people of European stock and Aborigines, some of whom still live primitively.

Early Exploration of Australia

During the great Age of Exploration in the 1500s, such navigators as Ferdinand Magellan and Francis Drake sailed around the world. But they sailed north of Australia. The first European to see Australia for certain was a Dutch Captain, William Jansz. Jansz sailed down the Queensland side of the Gulf of Carpenteria in 1606. The first landing was made by another Dutchman, Dirk Hartog, in 1616. Hartog landed on an island, now named Dirk Hartog Island, near Shark Bay in Western Australia.

Dutch exploration of the northern coast continued. In 1642 Abel Tasman discovered Tasmania, which he called Van Diemen's Land. But Tasman did not see the southern parts of the Australian mainland. In 1644 Tasman explored the northern coast of Australia. Although the Dutch had proved the existence of a great southern land, they did not like what they saw. Most of the coasts they visited were poor, dry land. They also feared the Aborigines. As a result, they soon lost interest in further exploration.

British Exploration and Settlement

More than 100 years passed after the Dutch decided to stop exploring Australia and the British arrived. In 1770 the British Captain James Cook went ashore at Botany Bay, an inlet near Sydney. He then sailed along the entire eastern coast of Australia and named it New South Wales. The British were interested in Cook's reports of the fertile eastern coast. In 1788 they established a settlement on the present-day site of Sydney. This settlement was for convicts transported from Britain.

Five years later, however, the first free settlers arrived. In 1797, they introduced Merino sheep and Australia's great sheep-rearing industry began. Meanwhile, exploration continued. In 1798–1799 George Bass and Matthew Flinders explored the coast of Tasmania. In 1801–1803 Flinders sailed all the way around Australia and mapped its coastline.

By 1810 about 12,000 Britons were living in New South Wales, Tasmania and on Norfolk Island. About one-third of these people were convicts. Despite clashes with the Aborigines, people began to explore the interior in 1813. Ten years later the first sheep stations were established at Canberra. In 1829 a colony was founded at Perth and in 1836 at Adelaide. The shipping of con-

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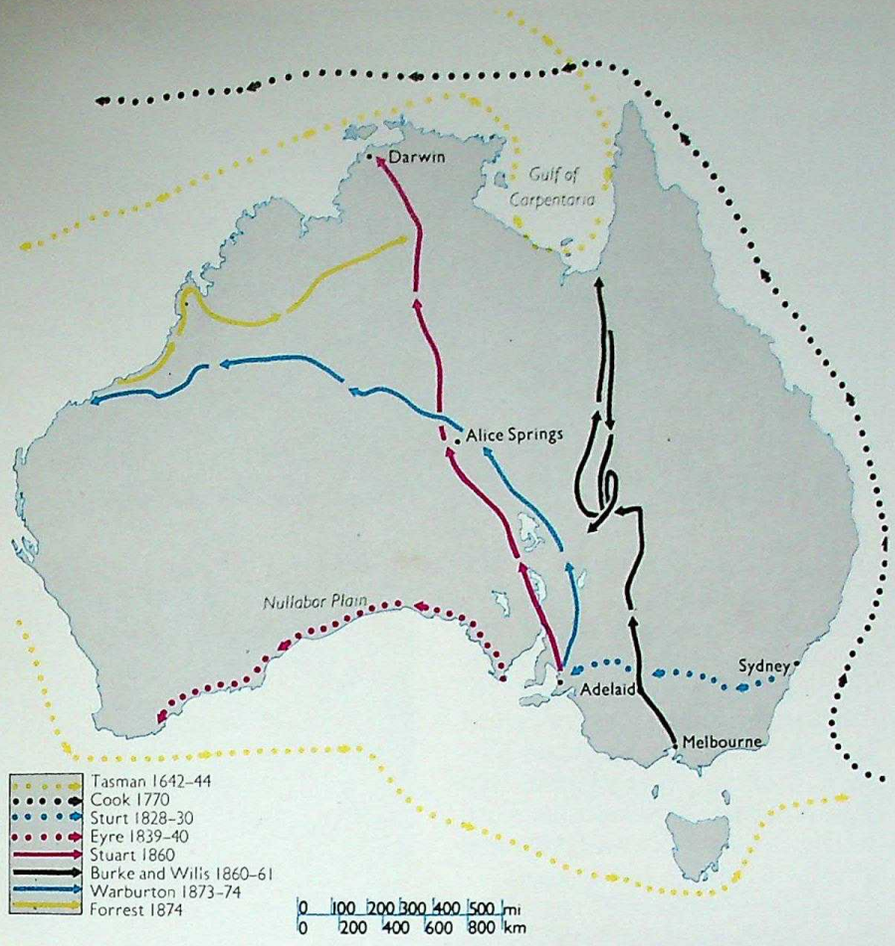

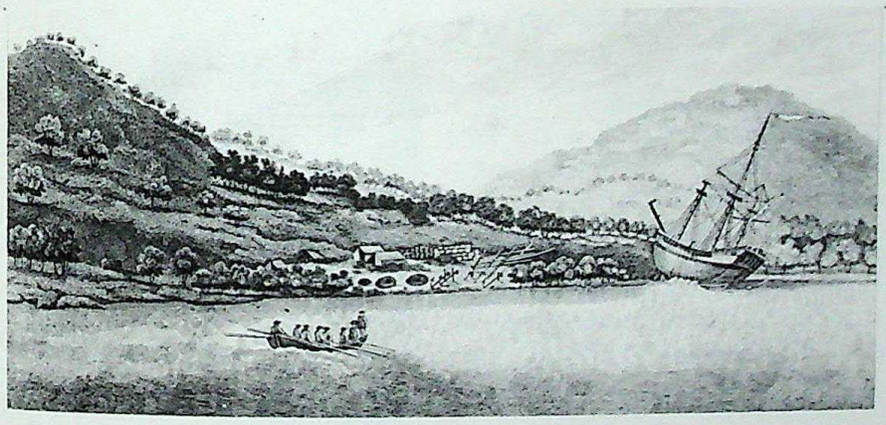

Top left: The routes taken by some of the early explorers of the Australian continent.
Left: A painting showing Captain Cook's ship *Endeavour* being repaired in 1770, near what is now Cooktown.
Top: Savanna-type country in Arnhem Land, in the north of Australia. There, many Aborigines follow their traditional ways of life.
Above: A warning to travellers about to sally forth into the great Australian desert.

victs to eastern Australia ended in 1852, but it continued in western Australia until 1868.

The population of Australia increased quickly during the gold rush of the 1850s in New South Wales and Victoria. Another gold rush occurred in the 1890s after gold was found at Coolgardie and Kalgoorie in western Australia.

Meanwhile, the exploration of the interior had been continuing. In 1860–61 Robert O'Hara Burke and William Wills became the first men to cross Australia overland from north to south. But they died on the way back.

The Commonwealth

In 1901 the states of Australia united in an independent Commonwealth. Northern Territory, previously controlled by South Australia, came under the rule of the federal government in 1911. By 1920 Australia had a population of about five million. British immigrants continued to swell the population. However, since 1945, when Australia's population numbered about 7,500,000, nearly half of the new immigrants have been non-Britons. They came from such countries as Germany, Greece, Holland, Italy and Poland. By 1976 Australia had an estimated population of just over 13 million.

The Climate

Australia is a warm country. Northern Australia is in the tropics and is warm the whole year round. South of the Tropic of Capricorn, the summers are warm but the winters are cooler. About two-thirds of Australia is too dry for farming. The north has monsoon rains in summer, but the south has winter rains brought by westerly winds. In many areas the rainfall is unreliable and

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droughts may occur. Australia has six main climatic regions: the tropical region, the desert region, the mid-latitude grassland region, the warm temperate region, the 'Mediterranean' region, and the cool temperate region.

The tropical region covers the north-eastern part of Western Australia, the north of Northern Territory, and much of Queensland. Monsoon rains are heaviest on the northern coast and on the north-east coast of Queensland. In the wetter regions, patches of tropical forests grow. However, inland, there is savanna (grass and trees) vegetation.

The hot deserts contain sandy desert and scrub. This region covers most of Western Australia, the south of Northern Territory, most of South Australia, and the eastern parts of New South Wales. This area covers more than 2,600,000 square kilometres (one million square miles), and it has less than 250 millimetres (10 inches) of rain per year.

The mid-latitude grassland region lies to the west of the Eastern Highlands in south-central Queensland and central New South Wales. It is an important farming region.

The warm temperate region includes the coastlands of New South Wales and south-eastern Victoria. Eucalypt forest is the typical vegetation.

The Mediterranean region has dry summers and moist winters. It occurs in the south-west of Western Australia, part of South Australia, and in western Victoria. Typical vegetation in this region is scrub woodland with mallee (a small eucalypt) and scrub with mulga (an acacia).

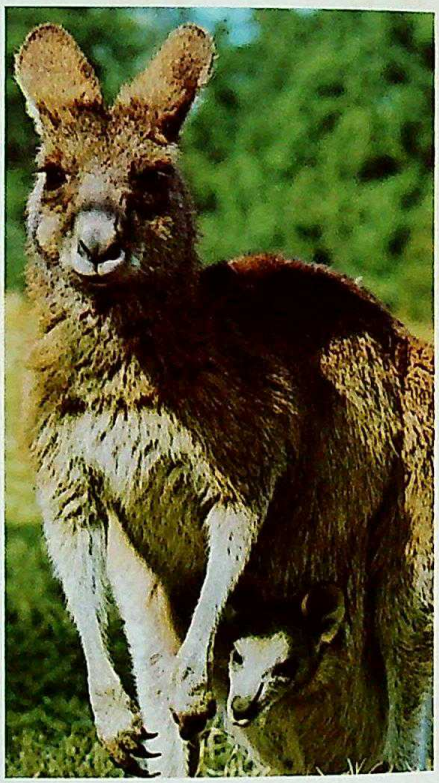
The cool temperate region of Tasmania has a climate similar to that of north-western Europe. Forests of beech and eucalyptus grow there.

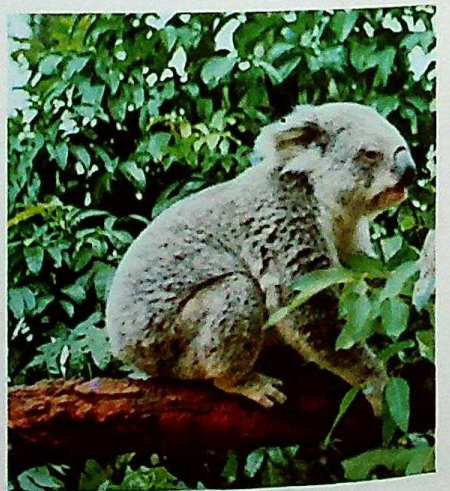
STATES AND TERRITORIES OF AUSTRALIA

State or Territory	Area Sq. Km.	Population 1976 est.	Capital
Australian Capital Territory	2,400	168,000	Canberra
New South Wales	801,600	4,702,000	Sydney
Northern Territory	1,346,000	96,000	Darwin
Queensland	1,727,200	1,915,000	Brisbane
South Australia	984,000	1,199,000	Adelaide
Tasmania	67,800	396,000	Hobart
Victoria	224,000	3,587,000	Melbourne
Western Australia	2,525,500	1,068,000	Perth

Australian Animals

Australia is well-known for its distinctive wildlife. The best-known group of animals are *marsupials* – mammals that carry their young in a pouch. Marsupials include kangeroos, koalas and wallabies. Another marsupial, the platypus, is a strange





The kangaroo and the koala bear, two of Australia's best-known animals, are both marsupials.

Often in Australia clouds are 'seeded' to make rain fall. This is done by injecting crystals from an aircraft.

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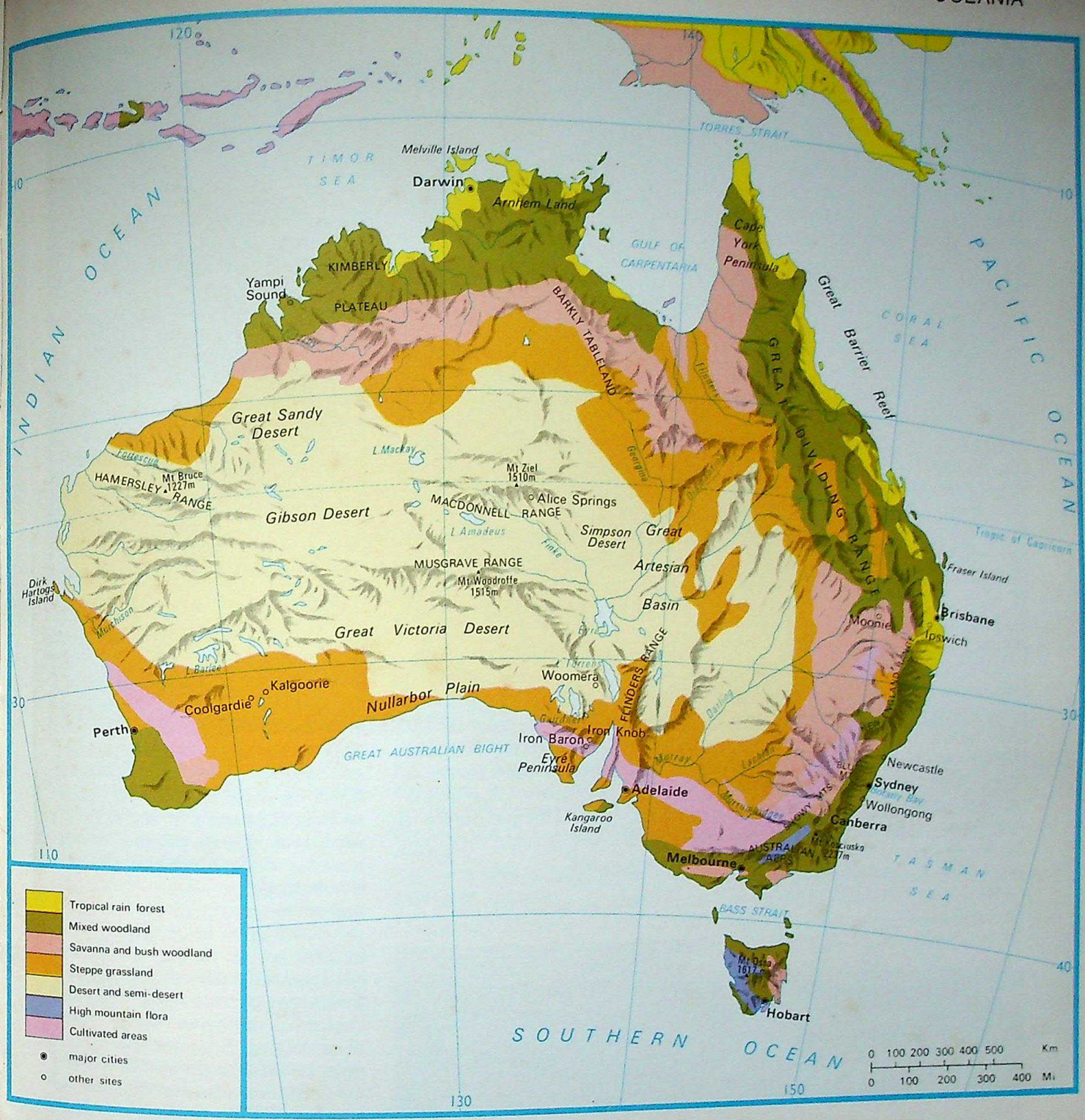

mammal which lays eggs. It has webbed feet, a duck-like bill and a furry coat.

Among Australia's birds are the flightless emu and cassowary. The beautiful lyre bird lives in the forests of New South Wales and Victoria. The dingo, a wild dog, was introduced into Australia thousands of years ago by the Aborigines.

Regions of Australia

The Eastern Highlands have an average width of about 240 kilometres (150 miles) and extend from Cape York in the north, through Queensland and New South Wales, to Victoria. The highlands continue beyond the shallow Bass Strait in Tasmania.

The Eastern Highlands are composed of fairly old, folded rocks, which contain many rich mineral deposits. In places the mountain peaks have been worn away to form high, broad plateaux. These highlands are also called the Great Dividing Range. They formed a barrier to early settlers on the eastern coast of Australia, making inland exploration difficult. The Eastern Highlands separate the headwaters of rivers that flow down the steep eastern side of the range to the Pacific Ocean, from the rivers that flow down the more gentle western slopes.

In most parts of Queensland, the highlands extend down to the sea. The Queensland highlands

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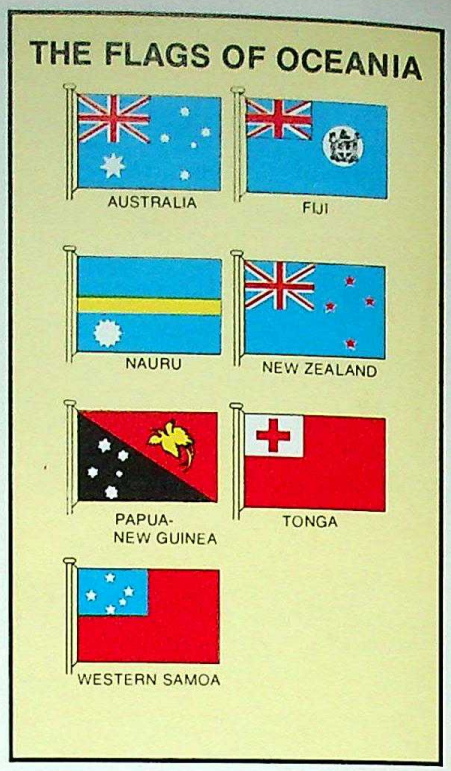
lie in the tropics and sugar cane is the chief crop. The main towns are mining centres or ports which handle mineral exports. Brisbane, Queensland's capital, is near Ipswich, which has a major coalfield. An oil pipeline connects Brisbane with the important Moonie oilfield, 305 km (190 miles) away. Off the coast of Queensland is the Great Barrier Reef, which is about 2,000 km (1,250 miles) long. It is the world's largest coral reef.

In New South Wales, the Eastern Highlands consist of the New England massif in the north, the Blue Mountains in the centre, and the Kosciusko massif in the south. The New England massif is so called because of its English character, with apple orchards and forests of deciduous trees. The Blue Mountains form a broad plateau cut by deep valleys. The Kosciusko massif contains Australia's highest point, Mt Kosciusko, which rises 2,240 metres (7,350 feet) above sea level. The Australian Capital Territory lies in this part of the Highlands. The New South Wales section of the Highlands is rich in minerals, especially coal. Newcastle, north of Sydney, is Australia's chief coal port. The Highlands are bordered by a temperate coastal plain. The coast has several fine harbours, including Port Jackson (Sydney Harbour).

The east-west Victorian Highlands are highest in the east in the Australian Alps. The snows of this region feed such rivers as the southward-flowing Snowy River and the westward-flowing Murray River. These rivers are used to produce hydroelectricity and to supply water for irrigation. The Great Valley of Victoria, containing Melbourne, separates the main highland region from coastal ranges along the Bass Strait. Beyond the Bass Strait lies Tasmania, a rugged island extension of the Eastern Highlands. Tasmania has a cool, temperate climate. It is a rich farming state, especially in the larger river valleys and on the coastal plains.

The Central Plains of Australia extend from the Gulf of Carpenteria in the north to the Great Australian Bight in the south. The plains consist mostly of younger rocks, which contain few minerals. Farming, especially livestock raising, is the chief activity. The northern part of the plains, including western Queensland, the south-eastern corner of Northern Territory, north-eastern South Australia and northern New South Wales, lie in the Great Artesian Basin.

Sugar cane being cut by machine near Cairns in northern Queensland, Australia.



Water for the cattle which graze on the grassy plains of western Queensland is obtained from *artesian wells*. The artesian water comes from the heavy rain that falls on the Eastern Highlands. This water sinks into the ground and flows westwards through tilted layers of porous rock – that is, rock through which water can percolate. These porous, water-bearing rocks underlie the dry Great Artesian basin. Above and below the porous rocks are other rocks, such as clay, which hold in the water. When wells are sunk, water gushes to the surface from the porous rock. Several thousand artesian wells have been drilled. Because the underground water reserves have been reduced, water now has to be pumped to the surface in most places. Artesian water usually contains a lot of dissolved minerals. While it is good for livestock, it is unsuitable for irrigating crops.

The south-western part of the Great Artesian basin is called the Lake Eyre basin. This thinly-populated area is a region of internal drainage. Lake Eyre is almost always dry. Its clay surface is covered by salt.

The most fertile part of the Central Plains is the south-east. This region is drained by the

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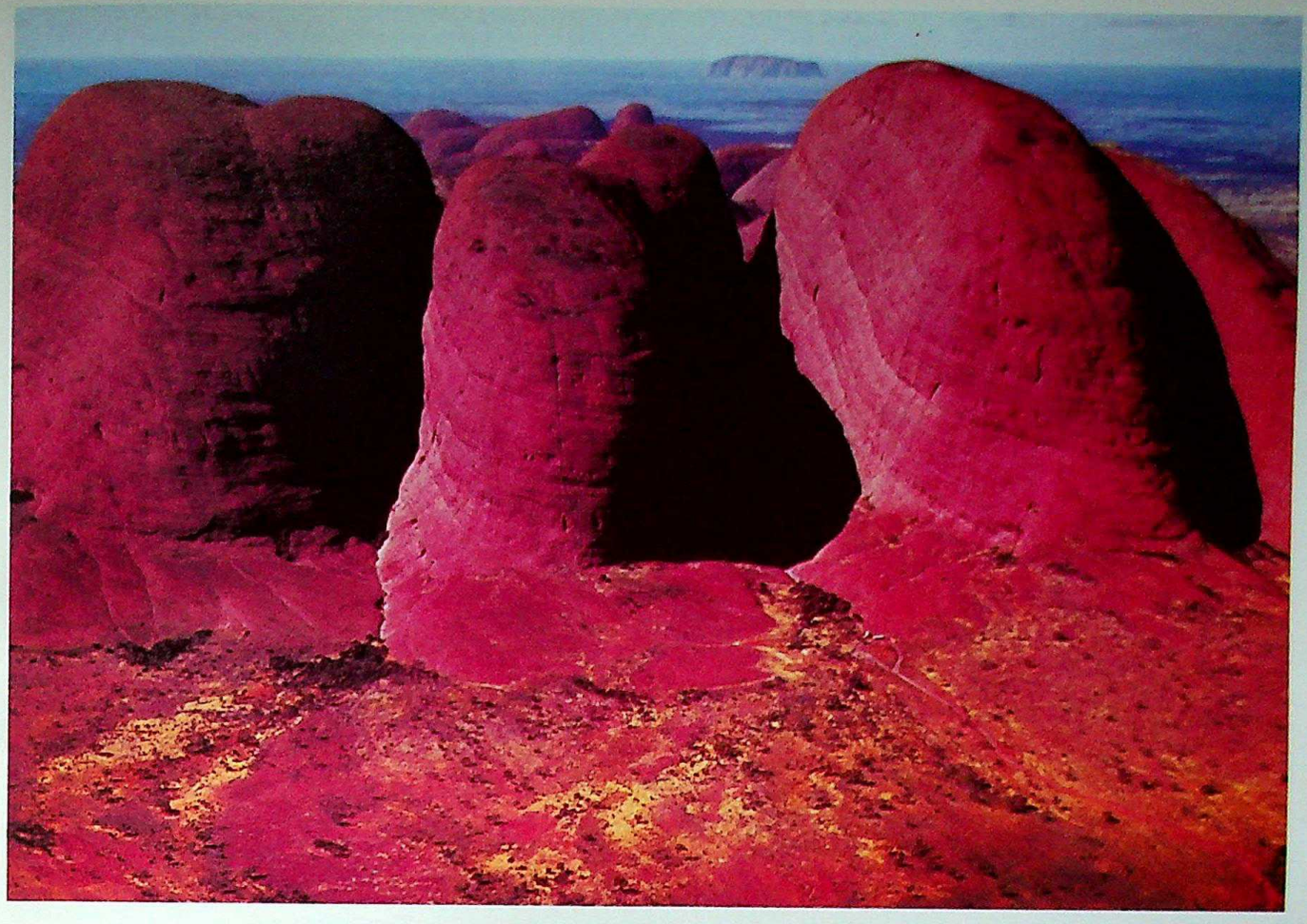


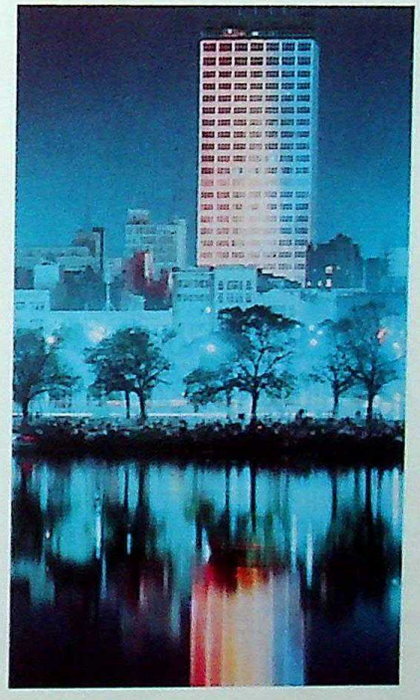
Above: Mt Olga, and in the background Ayers Rock, solitary lumps of rock that rise abruptly above a flat plain in the centre of Australia.
Below: A view of Melbourne, the capital of Victoria.

Murray River and its tributaries, the Darling, Goulburn, Lachlan and Murrumbidgee. Large flocks of sheep graze in this area and such crops as wheat and fruits are grown. In the south-west the Central Plains are broken by the South Australian Highlands. A Rift Valley region to the west of the highlands contains fertile plains. Adelaide is located in the southern part of the Rift Valley.

The Western Plateau includes the whole of Western Australia, most of Northern Territory and about a third of South Australia. The average height of this vast plateau is about 300 metres (1,000 feet) above sea level. In places mountain ranges rise above the plateau. For example, Mount Woodroffe in the Musgrave Range is 1,515 metres (4,970 feet) above sea level. In the west Mt Bruce reaches 1,227 metres (4,024 feet) in the Hamersley Range. There are important mineral deposits in the plateau.

Much of the Western Plateau is desert, with drifting sand dunes, dry scrub or dry savanna. In the south-east is a barren limestone plateau bordering the sea, called the Nullarbor Plain. *Nullarbor* means 'no tree'.

The Western Plateau extends to the sea in most places. The chief coastal plain is a narrow strip around Perth. This south-western area has a Mediterranean climate, and dairy farming and vine and fruit growing are important. Behind the coastal plain is an important wheat and sheep belt. The north and north-west of the plateau are covered by savanna woodland. Cattle grazing is important in this area.



The Economy

Australia's wealth still depends mainly on farming, especially livestock, and mining. But Australia has also recently become a major manufacturing country. The chief exports in 1973–1974, in order of value, were textiles, metals, meat, cereals, non-ferrous metals, coal and coke, transport equipment, sugar and honey, chemicals and iron and steel.

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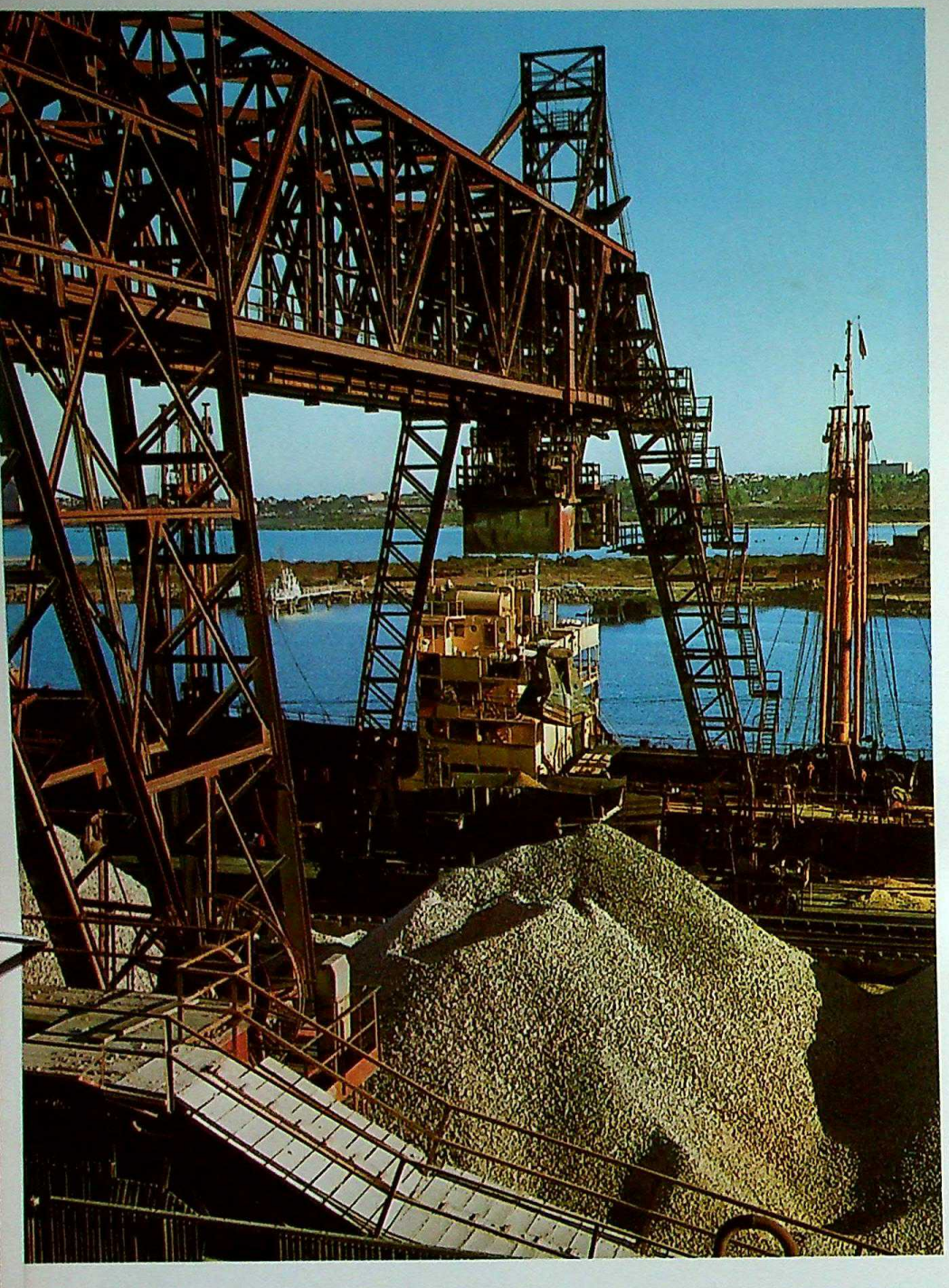

Iron ore being loaded at Whyalla, in South Australia. Whyalla is one of the leading iron and steel centres in Australia. It lies close to the iron-ore mining region of Iron Knob, in the Middleback Range.

Agriculture Australia has more than 148 million sheep and is the world's main producer and exporter of wool. Sheep thrive best in cool, dry areas, and the chief sheep-grazing regions in Australia are the temperate grasslands of the south-east. New South Wales and Victoria have more than half of Australia's sheep. Another important sheep belt is in the south-western part of Western Australia. Most Australian wool comes from the heavy-fleeced Merino sheep. Other breeds are kept mainly for their meat.

The chief beef-producing state is Queensland, which has more than a third of Australia's 29 million cattle. New South Wales and Victoria have important dairy farming industries along the wetter parts of their coasts. Pigs, horses and poultry are also raised.

Only a small part of Australia (about one-fiftieth) is suitable for crop farming. The chief crops are wheat, barley and oats, hay to feed dairy cattle, sugar cane, fruits, and grapes, especially for wine. The chief wheatlands are in the temperate grasslands and the Mediterranean regions. Sugar cane flourishes in the coastlands of Queensland. Deciduous fruits such as apples are leading products in Victoria, New South Wales, South Australia and Tasmania. Citrus fruit farms and vineyards are mainly located in the Mediterranean regions, and in the irrigated areas of the Murray River basin.

Forests cover about one-twentieth of Australia. Australia exports hardwoods and eucalyptus oil, obtained from the leaves of eucalyptus trees. In the north and north-east are tropical forests. In New South Wales and Victoria are the Blue Gum and other eucalyptus forests of the Eastern Highlands. In the South Australian Highlands are Stringybark and Blue Gum forests. In the south-western parts of Western Australia are forests of karri and jarrah. There are forests in Tasmania, too.

Mining Since the 1950s geologists have made many discoveries of mineral deposits, and mining has increased greatly in importance. Today Australia is one of the world's leading mineral producers. The most spectacular discoveries have been made in Western Australia, which was formerly best known for its gold mines. Today the chief mineral is iron ore, which is found especially in the Hamersley Range.

In terms of value (1972–1973), iron ore, coal and petroleum are Australia's most important minerals. Apart from the Hamersley Range, important iron deposits occur at Iron Knob and Iron Baron in South Australia and at Yampi Sound in Western Australia. New South Wales has the largest coalfields in the Southern Hemisphere; Victoria has massive reserves of lignite, a low-grade coal. The Moonie field in Queensland is a major petroleum-producing area, but Australia still imports much of its petroleum. Other important minerals

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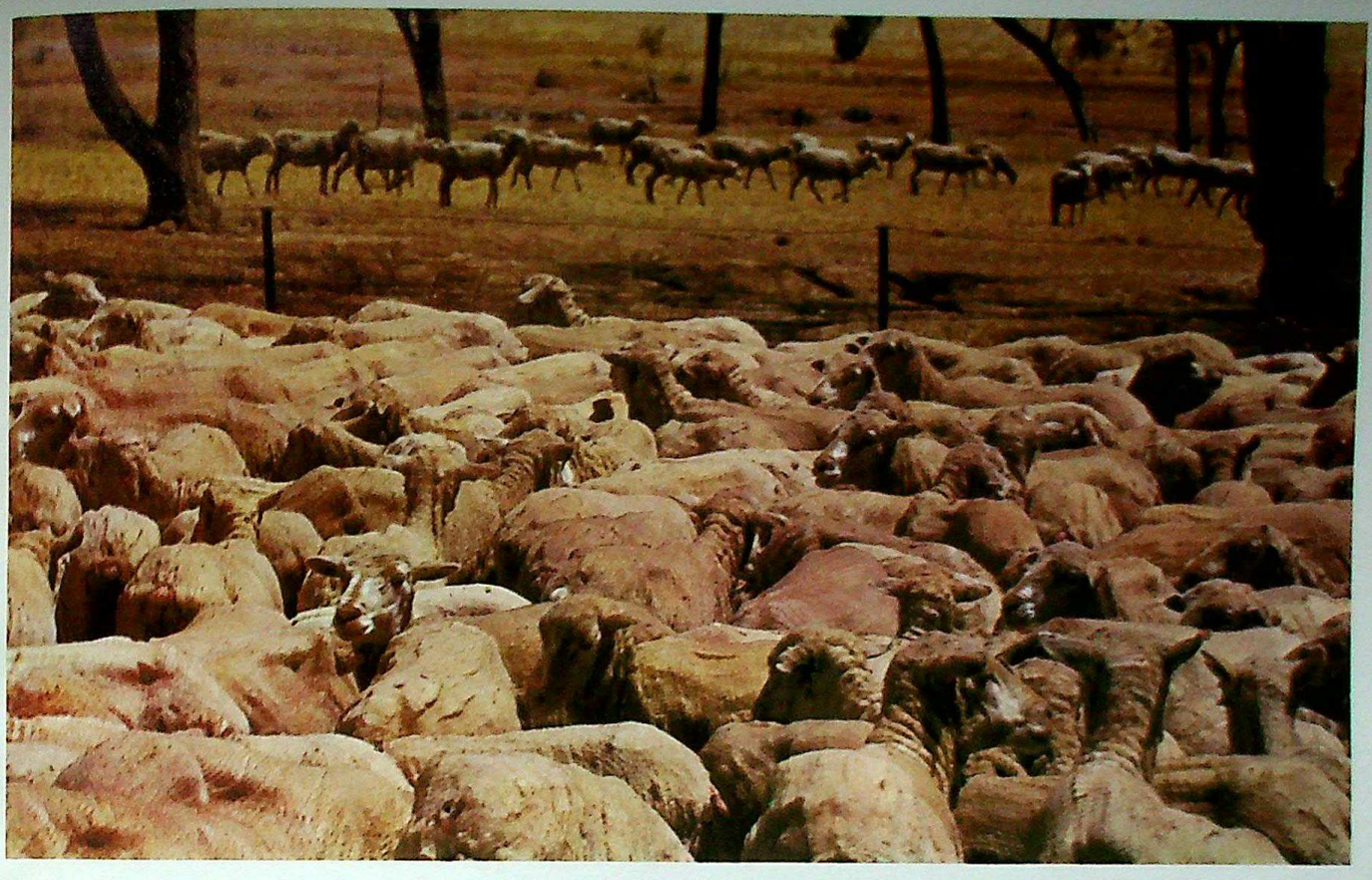
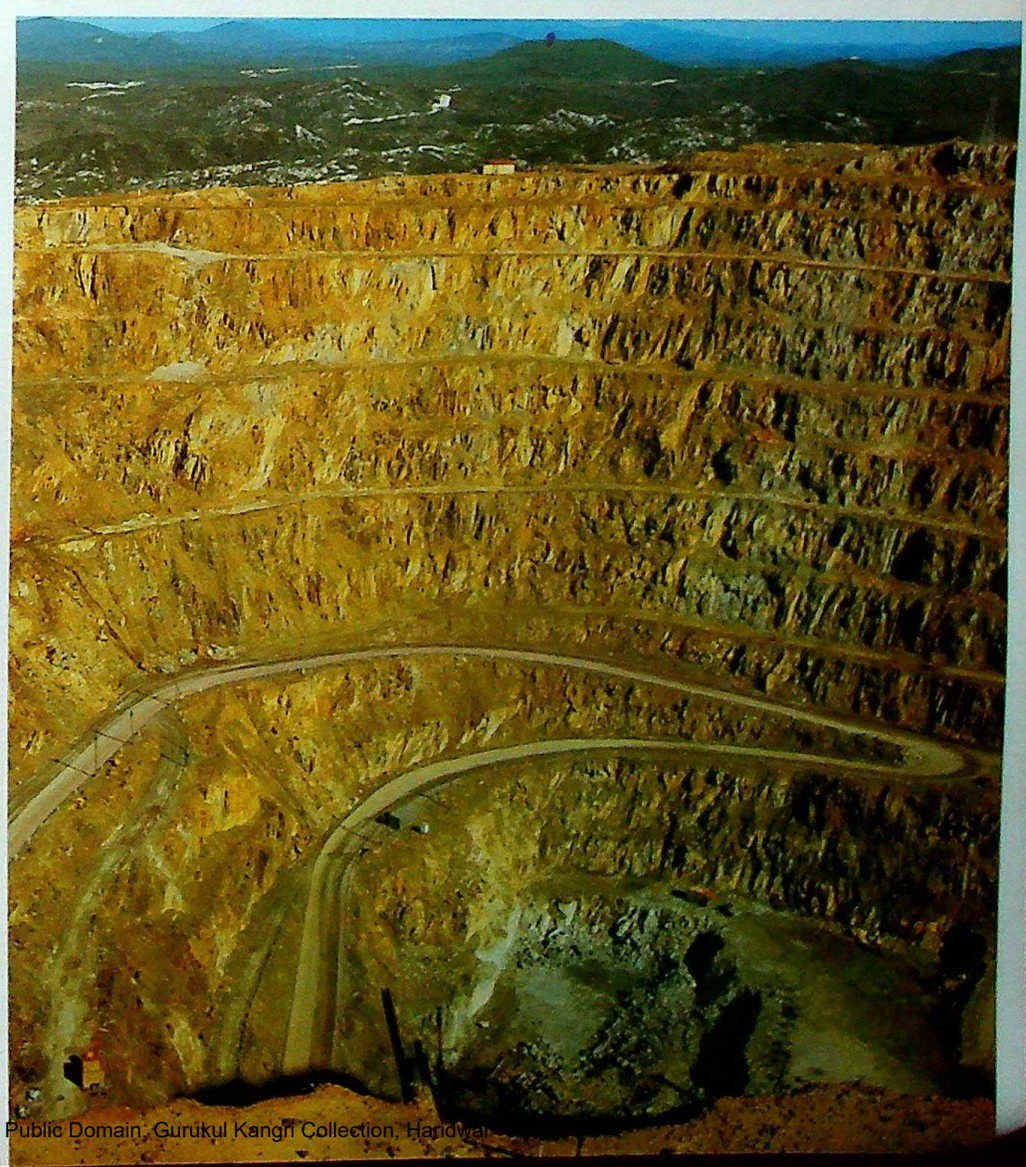


Above: Merino sheep just after shearing. Merinos, which are of Spanish origin, were first bred in Australia in 1796.
Right: A large open-pit gold mine in Queenstown, Tasmania. Australia has in recent years become one of the world's major mining countries.



produced in Australia are copper, lead, zinc, titanium and gold.

Manufacturing and Trade

Manufacturing has increased greatly in importance in Australia in the last 25 years. The older manufacturing industries were based on the processing of farm products, such as wool. But there has been a massive increase in the manufacture of consumer goods and in heavy industry. For example, steel production increased by six times between 1950 and 1970. The iron and steel industry is based mainly in New South Wales.

In recent years, the direction of Australia's trade has changed. Britain used to be Australia's chief trading partner. But today the value of Australia's trade with both Japan and the United States exceeds the trade with Britain.

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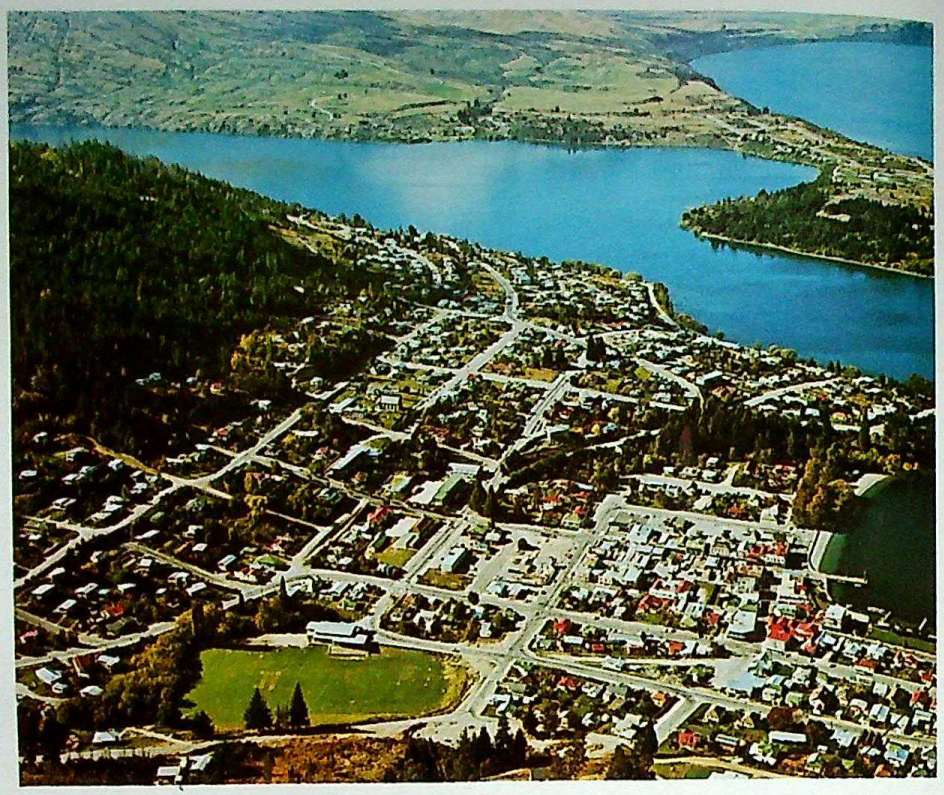
NEW ZEALAND

New Zealand is a small, beautiful country, with a mild climate. It consists of two large islands, called North Island and South Island, and several smaller islands. New Zealand covers a slightly larger area than England, Scotland and Wales combined. But New Zealand has far fewer people. It has only about 11 people to every square kilometre (29 per square mile). On average, England, Scotland and Wales have 235 people per square kilometre (over 600 per square mile).



Queenstown, a resort on Lake Wakatipu, the longest lake on New Zealand's South Island.

The Maoris

About nine out of every ten New Zealanders are of British descent. But long before Europeans knew of New Zealand, the country was populated by the Maoris. The Maoris are tall, brown-skinned people with black, wavy hair. They probably settled in New Zealand, chiefly on the coasts of North Island, in the AD 1300s. The Maoris came from Polynesia, the islands of the central and south-western Pacific Ocean. In New Zealand the Maoris lived by hunting, fishing and growing such crops as sweet potatoes. New Zealand has few large mammals, so the Maoris hunted birds, including the flightless kiwi. The kiwi is now the country's national emblem, but only a few survive in the wild.

The Maoris lived in villages in family groups or clans. Most villages had houses which were highly decorated with wood carvings. The Maoris decorated themselves with tattoos. They had many myths and legends. They believed that the Earth was once peopled by gods, such as *Papa* (the Earth mother) and *Rangi* (the sky father).

The Arrival of Europeans

The first European to see New Zealand was Abel Tasman, a Dutch sea captain, in 1642. The Maoris attacked and killed four of Tasman's crew. Because the Maoris were unfriendly, the Dutch did not send any more expeditions. The next European to explore New Zealand was the Briton, Captain Cook, in 1769. Cook sailed around North and South Island and made friends with the Maoris.

Between 1790 and 1850 traders, missionaries and whalers visited New Zealand. Their relations with the Maoris were difficult and fights often occurred. The Maoris also suffered by catching illnesses from the Europeans. In 1839, however, Britain agreed the Treaty of Waitangi with the Maoris. In this treaty, the Maoris agreed to become British subjects. They also agreed to allow Europeans to settle on the land.

New Zealand became a separate British colony in 1841. British settlement developed slowly at first. But it increased rapidly after the discovery of gold in 1861. When the gold ran out, many people stayed on as farmers. Ownership of the land created problems with the Maoris, who thought that they were being cheated by the settlers. They fought a series of wars against the settlers between 1845 and 1870. Although they fought with great courage, they were finally defeated. Hundreds of lives were lost during these wars, and by 1896 only about 42,000 Maoris were left.

In 1907 New Zealand became an independent dominion in the British Empire. The country made rapid advances. Farming was developed and much of the high-quality farm produce was exported, especially to Britain. The Maori population slowly recovered, although many intermarried with the settlers. Today there are about 227,000 Maoris.

Physical Features

High mountain ranges form the backbone of both North and South Islands. The Southern Alps of South Island are the highest, with 17 peaks over 3,050 metres (10,000 feet) above sea level. The highest peak, Mt Cook, is 3,764 metres (12,349 feet) high. Snow covers the highest parts of the Alps, and many glaciers extend from the snowfields. In the south-west there are deep *fiords* (sea inlets carved by glaciers). The many lakes and fast-flowing rivers of the Southern Alps are used to generate electricity. The

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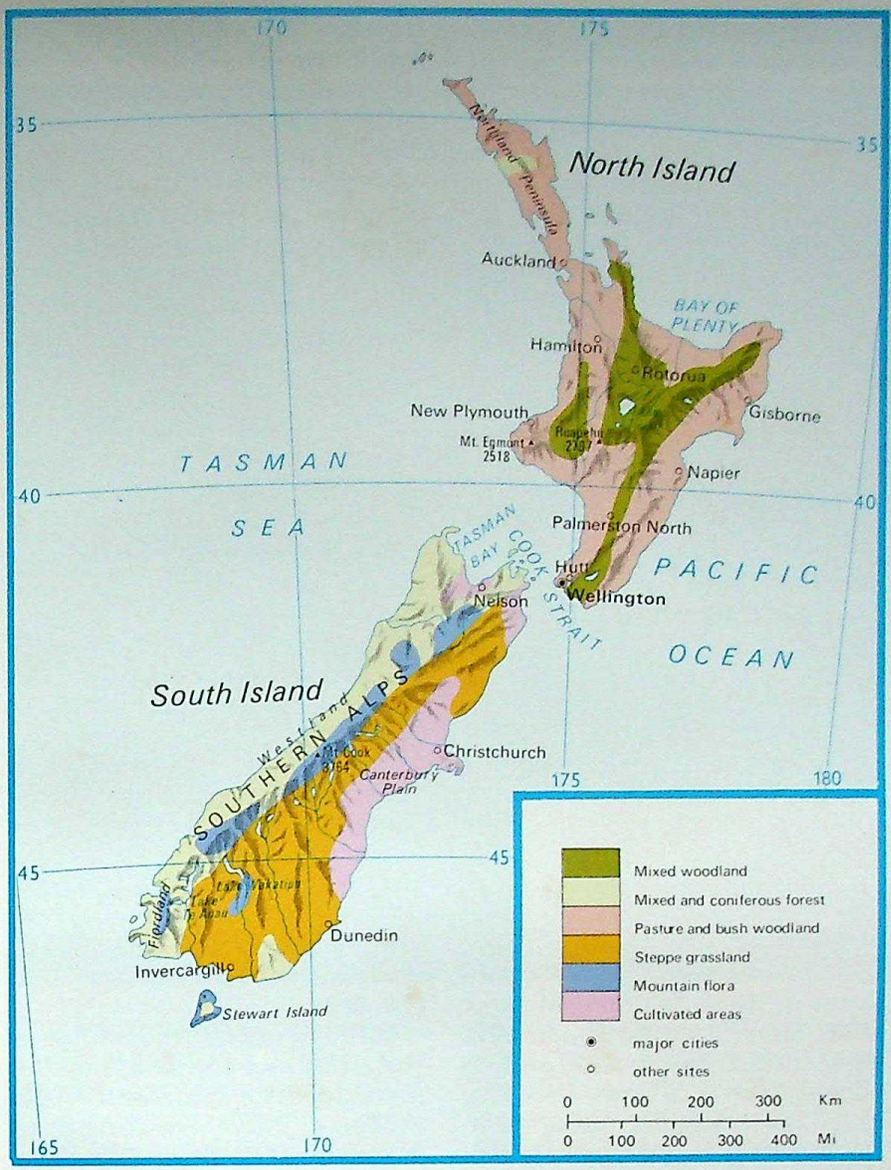


Alps slope steeply to the west, but the slopes are more gentle to the east. Around the coast are several regions of coastal plains. They include Westland, the area around Tasman Bay; the Canterbury plains in the east, and the south-eastern lowlands and hill country around Dunedin.

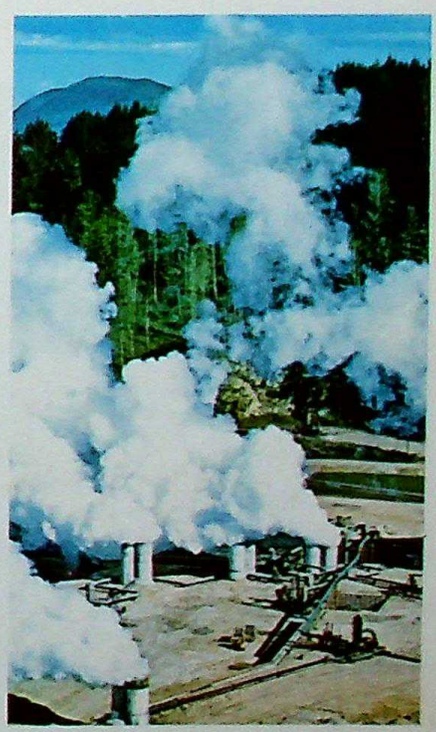
North Island has an eastern mountain range with peaks lower than those of the Southern Alps. North Island is also a centre of volcanic activity and earthquakes. There are several active volcanoes, such as Ruapehu, which is 2,797 metres (9,175 feet) high. North Island also has hot springs. Around Rotorua, geysers regularly shoot jets of hot steam and gas into the air. Around Lake Taupo, New Zealand's largest lake, the hot steam is used to generate electricity.

More than two out of every three New Zealanders live on North Island, especially on the broad, fertile coastal plains. Wellington, New Zealand's capital and second largest city, is in the southern part of North Island. The country's largest city, Auckland, is at the southern end of the narrow Northland peninsula.

NEW ZEALAND: NORTH AND SOUTH ISLAND 1974

District	Area Sq. Km.	Population	Chief Centre
NORTH ISLAND	114,725	2,200,500	—
Central Auckland	5,568	775,460	Auckland
East Coast	10,878	48,150	Gisborne
Hawke's Bay	11,033	141,000	Napier, Hastings
Northland	12,639	98,520	Whangarei
South Auckland	36,743	453,350	Hamilton
Bay of Plenty Taranaki	9,712	102,260	New Plymouth
Wellington	28,152	581,760	Wellington
SOUTH ISLAND	153,940	842,300	—
Canterbury	43,430	420,870	Christchurch
Marlborough	10,929	33,430	Blenheim
Nelson	17,896	71,160	Nelson
Otago	36,440	184,360	Dunedin
Southland	29,680	110,050	Invercargill
Westland	15,565	22,430	Greymouth

Steam from the hot springs at Wairakei on North Island is used to generate electricity.



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Climate

New Zealand has a cool, temperate climate. For example, Dunedin in the south has average temperatures of 6°C (42°F) in the coldest month (July), and 14°C (58°F) in the warmest month (January). North Island, which is in the same latitude as Mediterranean lands, is warmer. Auckland has an average temperature range of 11°C (52°F) to 19°C (67°F).

Westerly winds blow over New Zealand for most of the year. These winds bring rain, especially to western areas. Snow and heavy rain, amounting to between 2,540 mm and 5,080 mm (100–200 inches) per year, falls on the Southern Alps. But the eastern lowlands of South Island are dry. Most of the Canterbury plain gets less than 630 mm (25 inches) of rain every year. On North Island, the rainfall is more evenly distributed. Most falls in winter.

Vegetation and Animals

Forests once covered most of New Zealand. But they now spread over only about a quarter of the country. In South Island large beech and coniferous forests grow on the Southern Alps. But the dry east is scrub and rough pasture land. North Island's forests contain valuable softwoods, such as pine.

Apart from the tailless kiwi, New Zealand has several other interesting birds. They include the takahe, which was once thought to be extinct, and the shy weka, both of which are also flightless. New Zealand also has several parrots, such as the green kea parrot and the noisy kaka parrot. The tuatara is a rare New Zealand reptile – a survivor from the age of the dinosaurs.

Economy

New Zealand's wealth is based on its farming. About two-thirds of New Zealand is suitable for agriculture. Pastoral farming, especially the rearing of sheep and cattle, is the chief agricultural activity. New Zealand's farming is highly mechanized. Fleets of aeroplanes are used for seeding and spreading pesticides and fertilizers over the land. The chief farm exports, in order of value, are wool, beef, lamb, butter, hides and skins, milk powder, cheese and mutton.

There are about 32,000 sheep farms in New Zealand. Most of them have large flocks. In 1973 New Zealand had about 57 million sheep. They are kept both for their wool and for their meat. Some sheep are Merinos, which are famous for their wool. Others are Corriedales, which are crosses between Merinos and other English breeds.

In 1973 there were about nine million beef and dairy cattle in New Zealand. The best grazing regions are the moist pastures of North Island. The cattle can graze all the year round because the climate is so mild. The dairy farms are generally small. About three-quarters of the cattle are Jerseys, which give excellent milk. Pigs and poultry are also kept by some farmers.

Arable farming is less important than pastoral farming. Wheat is the chief crop. It is grown in Canterbury and North Otago. Oats and other fodder crops are grown for animals. Maize, potatoes, tobacco and fruits are also important. Sea fishing is important around the coasts.

Although farming is the most valuable activity, about two out of every three New Zealanders live in towns and cities. The largest cities are Auckland (population 775,000), Wellington–Hutt (346,000), Christchurch (320,000), Hamilton (147,000) and Dunedin (120,000).

Manufacturing industries in the cities and towns are mainly involved with processing farm products. There are leather industries, using hides and skins; woollen cloth industries; dairy-produce industries, producing butter and cheese, and timber and wood-pulp industries. Mining is not a very important industry in New Zealand. Most of its gold has already been mined, but there are deposits of iron ore, petroleum and low-grade coal. Most of New Zealand's electricity is produced by water power.

Britain is still New Zealand's leading trading partner, although such countries as Japan and the United States have greatly increased their share of the trade in recent years. When Britain became a member of the European Economic Community (EEC), many New Zealanders feared that their trade with Britain might decline. But the EEC, at Britain's request, has made special arrangements for New Zealand produce to be sold in the EEC.

New Zealand has a thriving timber industry. Here logs are stacked at a pulp mill.

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THE PACIFIC ISLANDS

Borabora, in the Society Islands, is a typical volcanic island ringed by a coral reef.

The Pacific islands of Oceania are mostly of two kinds. Some are the tops of volcanoes which have grown up from the ocean floor. Others are low-lying coral islands, called *atolls*. Many of the volcanic islands are fringed by coral reefs.

Most of the Pacific islands are in the tropics and have warm, humid climates. On the mountainous volcanic islands the rainfall is often heavy, and thick tropical forests grow on the fertile plains and mountain slopes. The plant life on the coral islands is more limited. The coconut palm is found around the coasts of both kinds of islands.

The many islands are divided into three main groups based on the kinds of people who were the original inhabitants: the Melanesians, the Micronesians and the Polynesians.

Melanesia

Melanesians are stocky, dark-skinned people with fuzzy hair. The word *Melanesia* means *black islands*. It refers to the dark colour of the Melanesians' skins. The Melanesians live on islands to the north and north-east of Australia. These islands include Fiji, New Caledonia, New Hebrides and the British Solomon Islands. Melanesia also includes part of the large island of New Guinea. However, the western part of New Guinea, West Irian, is part of Indonesia. As a result, it is usually regarded as part of Asia, not Oceania. The eastern part of New Guinea is called Papua/New Guinea. This part was ruled by Australia until 1975, when it became independent. Most of the people of Papua/New Guinea are Melanesians, but there are also Negroid non-Melanesians.

Papua/New Guinea forms the largest land mass in Melanesia. It is only about 160 kilometres (100 miles) from the northernmost tip of Australia. Most of the people are farmers, and the most valuable crops are coconuts, cocoa, coffee and rubber. The timber industry is also important. The capital, Port Moresby, is the commercial and industrial centre. Papua/New Guinea contains lofty mountain ranges which reach 4,694 metres (15,400 feet) in Mount Wilhelm. Alpine plants grow on the higher parts of the mountains. On the lower slopes and plains, however, there are dense tropical forests and swamps. The most thickly populated areas are open, grassy valleys which lie between some of the mountain ranges. The territory has heavy rainfall, which fills its many rivers. The longest is the Fly River, which is 1,130 kilometres (about 700 miles) long. Papua/New Guinea, like Australia, has several marsupials, including possums and wallabies. Birds include the flightless cassowary and birds of paradise.

The volcanic Fiji islands are surrounded by coral reefs. Fiji

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became independent from Britain in 1970. Its wealth depends on the export of sugar, coconut oil and some gold. New Caledonia is ruled by France while New Hebrides is governed jointly by France and Britain. New Caledonia has large mineral reserves, with nickel the chief export. New Hebrides exports fish, copra and some manganese.

Micronesia

The word *Micronesia* means *small islands*. The Micronesians have brown skins and straight black hair. They are short, muscular people with dark eyes. They live on islands scattered over 7,770,000 square kilometres (3,000,000 square miles) of the central Pacific Ocean. Micronesia includes the Caroline and Gilbert Islands, Guam in the Mariana Archipelago, and the Marshall islands.

Many Micronesians are fishermen. They also grow such crops as bananas, breadfruits, coconuts, sweet potatoes, taros and yams. The United States rules the Caroline, Mariana and Marshall islands. The Gilbert Islands are British.

Polynesia

The name *Polynesia* means *many islands*. Polynesians are tall people with brown skins. They live on islands that lie roughly within a triangle formed by New Zealand, the Hawaiian islands and Easter Island. Polynesia also includes American Samoa, the Ellice Islands, French Polynesia, Tonga and Western Samoa.

The Polynesians of New Zealand are the Maoris, who settled there in the AD 1300s. Hawaii has been a state of the United States since 1959. Its Polynesian people depend on agriculture and tourism for their living.

The remote Easter Island is about 3,860 kilometres (2,400 miles) from South America. It is governed by Chile. It is notable for its 600 huge stone busts dating back more than 1,500 years. The volcanic islands of American Samoa have fishing, copra and tourist industries. The nearby Western Samoa became independent in 1962.

IMPORTANT ISLANDS OF OCEANIA

	Area Sq. Km.	Population 1975 est.	Capital
Melanesia			
Fiji	18,272	572,000	Suva
New Caledonia	19,058	126,000	Nouméa
New Hebrides	14,763	93,000	Vila
Papua/New Guinea	461,691	2,611,000	Port Moresby
Br. Solomon Is.	28,446	191,000	Honiara
Micronesia			
Caroline Is.	1,050	60,000	Saipan (Marianas Is.)
Gilbert Is.	264	48,000	Tarawa
Guam	549	98,000	Agana
Marshall Is.	181	25,000	Saipan (Marianas Is.)
Polynesia			
American Samoa	197	35,000	Pago Pago
Easter Is.	165	1,000	Hangaroa
Ellice Is.	24	6,000	Tarawa (Gilbert Is.)
French Polynesia	4,000	128,000	Papeete
Hawaiian Is.	16,640	770,000*	Honolulu
New Zealand	268,676	3,072,000	Wellington
Tonga	699	96,000	Nuku'alofa
Western Samoa	2,842	158,000	Apia

*1970 census.

Fijian men perform a ritual war dance with clubs on the beach at Vitu Levu, the main island in the Fiji group. The native inhabitants of most of the Pacific Islands have similar traditional dances.

The Ellice Islands are British. French Polynesia consists of many islands scattered over a large area. It includes the beautiful island of Tahiti. Tonga became independent from Britain in 1970.

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ANTARCTICA

LAND OF SNOW & ICE

Antarctica is the fifth largest continent. It covers about 13,208,000 square kilometres (5,100,000 square miles). Usually, no more than 1,000 people live in this bitterly cold, bleak, snow-covered land. Most of these people are scientists who are studying such things as the continent and its resources, its weather, and Earth magnetism and gravity. These scientists get all their supplies from outside Antarctica. Without regular supplies, they could not survive.

Simple plants, such as lichens and mosses, grow around the coasts of Antarctica, and some lichens have been found inland, close to the South Pole. Most Antarctic animals live either in the sea or on the coasts. Whales and seals live in the waters around the continent, but their numbers have been reduced by hunting. The bird life includes the largest of all penguins, the one-metre ($3\frac{1}{2}$-foot) high Emperor penguin, and the more common Adélie penguin.

Climate

The main features of the climate of Antarctica are its dry, cold air and strong winds. The inland

An icebreaker smashes its way through the gathering pack ice in McMurdo Sound, Antarctica.

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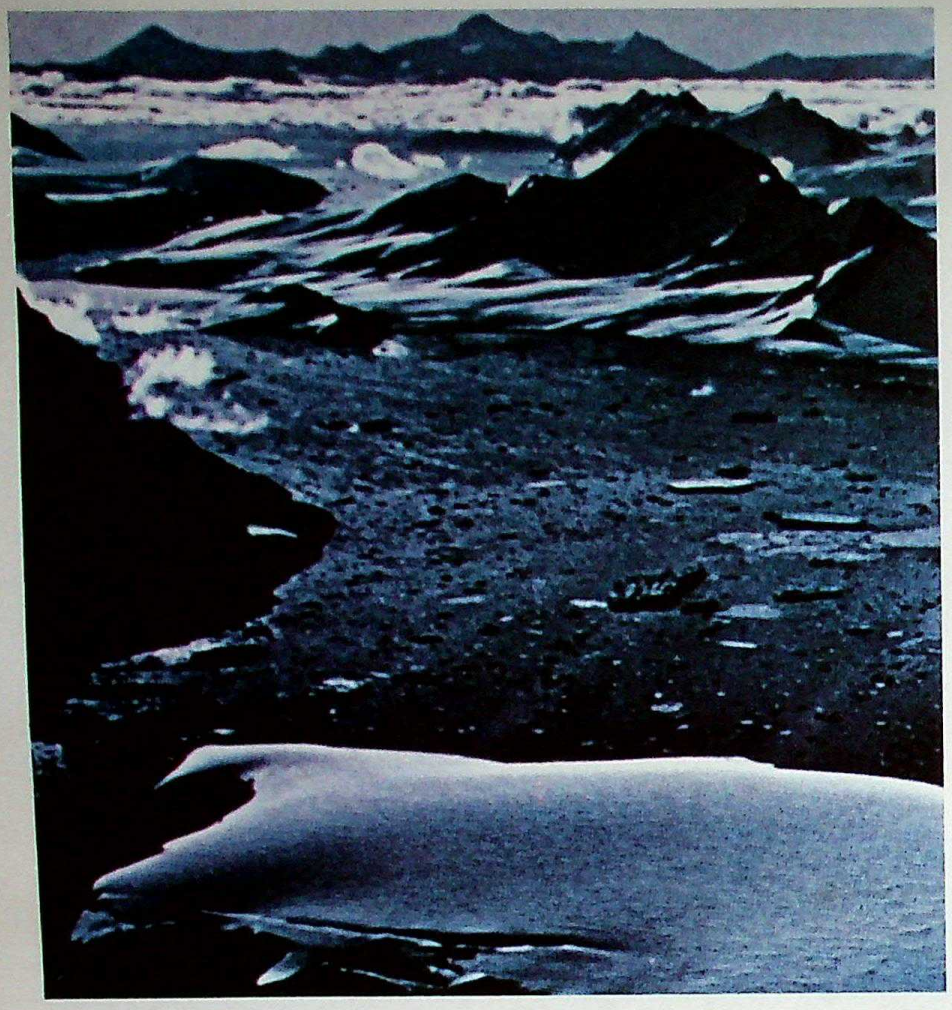


A typically bleak Antarctic scene, showing an iceberg wedged up against the shore.

areas are the coldest places on Earth, where winter temperatures drop to around −73°C (−100°F). The world's lowest recorded temperature, −88.3°C (−126.9°F), was measured in 1960 at the inland Russian scientific station at Vostok. Around the coast, temperatures are less extreme. They range from about 0°C (32°F) in midsummer (December) to −20°C (−40°F) in midwinter (June).

The air over Antarctica is so dry that the average annual snowfall at the South Pole is the equivalent of only about 150 millimetres (6 inches) of rain. In many places, the snowfall is less. This means that Antarctica, although it is covered by snow and ice, has a climate as dry as that of the Sahara desert. Snowfall is difficult to measure, because blizzards are common. Blizzards are caused by fierce winds blowing surface snow around.

Snow and Ice

Although the average annual snowfall is small, snow has piled up over many thousands of years to form a great ice sheet. This ice sheet covers almost all of the continent.

This ice slowly moves outwards and downhill towards the sea. In some places near the sea, it flows through valleys as glaciers. In other places, the ice sheet extends over the sea in large *ice shelves*, bordered by ice cliffs. When chunks of the ice shelf break away, they form enormous icebergs, usually rectangular in shape. Most icebergs are more than 1.6 kilometres (1 mile) long, and some are very much bigger. One of the largest icebergs sighted was 145 kilometres (90 miles) long and between 30 and 40 metres (100–130 feet) high.

Scientists estimate that the ice sheet of Antarctica consists of more than 29 million cubic kilometres (7 million cubic miles) of ice. If all the ice in the ice sheet and ice shelves were to melt, the sea level around the world would rise by about 60 metres (200 feet). The world's great ports would disappear, and some of the world's most fertile lowlands would be flooded.

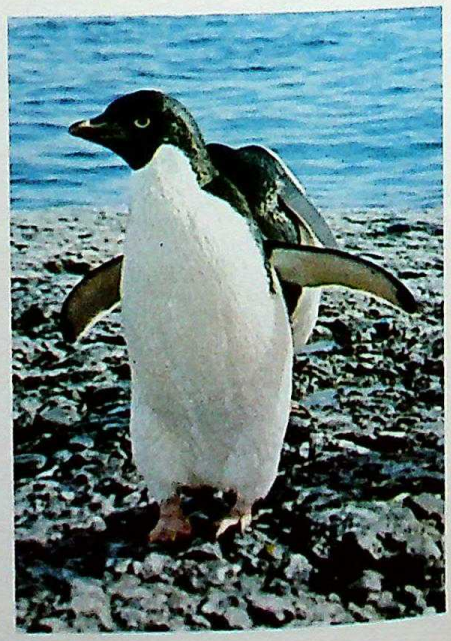
Bare rock borders some parts of the coast of Antarctica. It also occurs inland where the peaks of high mountains jut out through the ice sheet. These exposed peaks are called *nunataks*.

Physical Features

Antarctica is roughly circular in shape and is enclosed by the Antarctic Circle. But the circle is broken by two large bays, the Ross and Weddell seas, and the Antarctic Peninsula, which juts out towards South America. The waters around Antarctica are sometimes called the Antarctic or Southern Ocean. This ocean is really an extension of the Atlantic, Indian and Pacific oceans.

From a study of the rocks of Antarctica, scientists believe that Antarctica was not always located around the South Pole. For example, coal beds have been found in Antarctica. Coal was formed from giant plants which grew millions of years ago in a warm climate. Scientists believe that, about 200 million years ago, Antarctica was close to Australia and the southern parts of Africa and South America. The conti-

The most numerous wildlife in Antarctica are penguins, which live near the coasts.



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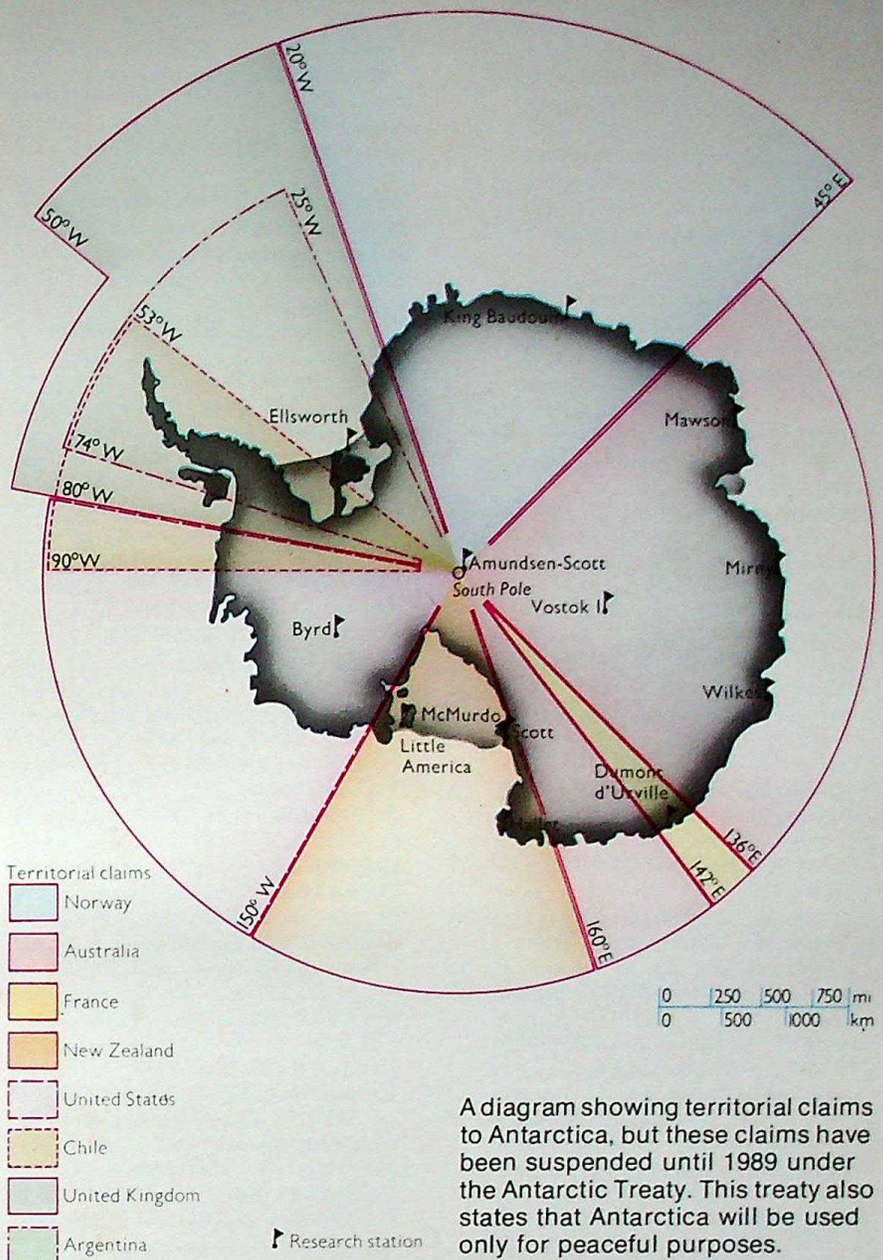
nents have since drifted slowly to their present positions.

Antarctica is divided into two main regions – Eastern and Western Antarctica – by a lofty mountain range called the Transantarctic Mountains.

Eastern, or Greater Antarctica is a high plateau facing Africa, the Indian Ocean and Australia. It contains the South Pole, where the ice is nearly 2,740 metres (9,000 feet) thick.

Western, or Lesser Antarctica is divided by mountain ranges. The ice is 4,270 metres (14,000 feet) thick in places, and much of the land beneath the ice is below sea level. Western Antarctica includes the volcanoes Mts Erebus and Melbourne. Antarctica's highest point, the Vinson Massif, is at the landward end of the Antarctic Peninsula. It is 5,085 metres (16,684 feet) above sea level.

Antarctica was the last continent to be explored. Between 1800 and 1820, American and British seal hunters saw offshore islands and parts of the Antarctic Peninsula for the first time. In 1821 an American seal hunter, Captain John Davis, became the first man to set foot on the mainland, at Hughes Bay on the Peninsula. In the 1820s a Briton, James Weddell, sailed into the Weddell Sea. In 1841 another Briton, Sir James Clark Ross, discovered the Ross Sea and the Ross Ice Shelf.



A diagram showing territorial claims to Antarctica, but these claims have been suspended until 1989 under the Antarctic Treaty. This treaty also states that Antarctica will be used only for peaceful purposes.

The Race to the Pole

There was no further expedition of discovery until the 1890s. Between 1895 and 1900, Belgian, British and Norwegian parties landed on the mainland and some of them stayed for some time. The race to be the first man at the South Pole took place in the early 1900s. The British Captain Robert Falcon Scott got to within 925 kilometres (575 miles) of the Pole in 1905 and Sir Ernest Shackleton fell only 156 kilometres (97 miles) short in 1908.

In 1911 Scott returned for a second attempt. But 12 days before Scott set out, the Norwegian Roald Amundsen left for the Pole. Amundsen arrived at the South Pole on December 14, 1911. When Scott got there on January 18, 1912, he found a Norwegian flag stuck in the snow. Amundsen returned safely but Scott and all his companions perished.

Polar exploration by land was difficult and dangerous. In 1929 the American Richard Evelyn Byrd flew over the South Pole. Since then, much of the mapping of this desolate continent has been done by aerial photography.

Antarctica Today

Today Antarctica is an important centre for scientific research. Seven nations – Argentina, Australia, Britain, Chile, France, New Zealand and Norway – have claimed parts of the continent as their own territory. But in 1959 these nations and five others, including the United States and the USSR, signed the Antarctic Treaty. Under this treaty, the countries agreed that no claims would be settled until 1989.

Whaling is the only important economic activity in Antarctica. Two-thirds of the world's whaling industry is based in the seas around the continent. The industry is now controlled because of the danger of whales becoming extinct. Some scientists consider that Antarctica's minerals might be mined in the future. Others have suggested that it might be possible to tow giant icebergs to desert regions and use the ice as fresh water.

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